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Serving the Profession

ENGINEERING literature approaches its highest practical value in such an article as that on multiple-arch dams by R. P. McIntosh, on another page of this issue. Not enough dams of this type have been built to have established an accepted technique of design, but there will be a growing use with an increasing knowledge of their possibilities. For that reason an engineer who has grounded himself in the little-known details of the dam's design serves his profession well by so definite and comprehensive an analysis as Mr. McIntosh has prepared.

No Oppression by any Group

OUR emphasis of the need for the President to take the leadership in enunciating sound doctrine in the present economic crisis has been vindicated by the events of last week. The officers of the American Federation of Labor and of the railroad shopmen's union have hearkened to his appeal and will postpone for 90 days the threatening shopmen's strike. Under his exposé of their striking when an arbitration proposal was pending, the shopmen returned to work; while similarly the strike of California trainmen collapsed when the Director General of Railroads put the case before the country, telling the public that the employees were out contrary to the instruction of their own officers and to their agreement with the Government. In critical issues public opinion rules. Consequently, a strong leader who is in the right, who stands firm and who fearlessly goes before the country, is sure to win. Unjust employers of the autocratic type long since have felt the heavy hand of public opinion—witness the present labor laws. The railroads in their sorry plight are an example of the vengeance of the people. As employers have had to learn the lesson so, too, must employees.

Real Cost of Highways

ALTHOUGH reference is made on the front cover to the article by Mr. Breed (p. 450), giving facts and figures on New York State highway work, the subject is important enough to warrant repetition in these columns. While spending millions on road construction, the people have been giving little heed to what they are getting for their money. They are told, officially, that so many *miles* of road have been built, and this information has seemed to satisfy them. In the face of present high costs, however, it is not likely that this complacency will long continue. When the taxpayers, after paying for the construction of nondurable types of highway on heavily traveled routes, are called upon again, in a few years, for funds to *reconstruct* these same routes, they begin to see that mere "mileage" means very little. The lesson is made still more impressive when the fact is realized that much of this construction, as is the case in New York, is done with funds from 50-year bonds. In New York it has been necessary to reconstruct 1594 miles of highway in order to retain 6912 miles originally built. Mr. Breed presents data, on cost and life of roads, covering a 21-year period. Particular value attaches to such information as this, for it supplies evidence which can be used in supporting economically sound policies of state highway construction.

Getting Engineering Retainers

CONSULTING engineers are properly inclined to be conservative when they speculate on the legitimacy of methods of obtaining retainers. Some, the profession knows to its regret, are not scrupulous, but we are speaking here of those who want to stay within ethical bounds. Some of these, recent conversation shows, are inclined to lean so far backward as to have a deadly horror of anything that savors of salesmanship. Methods of "promotion," however, are as varied as men and products. They range from flamboyant advertising and diamond-studded effrontery to a quiet call on a client fully satisfied with a previous engagement. Recently we talked with an able engineer who desired to move to a more attractive locality, but who foresaw slow progress by reason of his lack of acquaintance. On the very same day a member of a successful engineering firm from the same city came to inquire as to prospective engineering enterprises on which consultants are employed. To our surprise he and his partners were awaiting developments and had not even called upon their long list of influential and satisfied clients to learn what new work was in prospect. These men were neglecting an asset, the lack of which may deter the other inquirer from changing his residence and professional practice to the city in question. Common business prudence is surely warranted in the conduct of an engineering office. The firm referred to may properly go well beyond the obvious step of keeping in touch with their former clients and might well suggest that the latter use their influence in favor of the firm when, in directorates and otherwise, the need of engineering services comes up for discussion. Many an engineer will remark that we had better concern ourselves with the curbing of engineers who overstep professional bounds, and that there is no need to encourage promotional work. We had been inclined to that view ourselves, but recent experiences show that there are in our ranks some—probably many—fine-grained, able men who lean over backward.

Crediting the Army's Engineers

WE HAVE received a letter from a former major of Engineers, with which we have much sympathy. He had sent *Engineering News-Record* an article on his water-supply work in France, which treated mat-

ters covered to some extent in Mr. Tomlin's articles, but which might nevertheless have been acceptable were it not that our readers want peace, not war, data. During the conflict we devoted much space to war work. With the signing of the armistice the whole country applied itself to the restoration of normal conditions. Our readers no longer wanted military articles, and we promptly addressed ourselves to the task of helping them return to their normal mode of thinking. Yet, note the sound ring of these words from our correspondent when our position was made known to him: "You take the same attitude as the thoughtless, careless citizen in the street. 'The war is over—forget it!' This notwithstanding the facts that the peace treaty is not yet ratified by our country, we still have thousands of soldiers in France, the Mexican situation is as critical as ever, our military establishment is again struggling with inadequate appropriations, and we are as far from adopting a sound military policy as ever—perhaps farther, if all magazines adopt your policy. I congratulate you that while the war was in progress you gladly gave a large amount of space to it, but I also deeply regret that engineer officers who were anonymous during the war must now forever remain so, so far as your publication is concerned." With this point of view we deeply sympathize. Those men who put through the great enterprise should have due credit. To put their names on a bronze tablet is not enough. In the records of the War Department the methods employed will be set down; the technical side will thus be cared for. As for the personal element, the organizations, not the individuals, will be credited in the military records. One suggestion may be in order—that addresses on war work would be excellent additions to engineering society programs this winter. There the speaker can inject anecdote and personality and relieve the formal recital of work that to his hearers will have interest merely and not direct value.

War Designs in Peace Work

OBVIOUSLY, there may be military engineering procedures and developments that throw light on the design and methods used in peace. These should certainly come to light. They are as much a part of the substantial treasury of professional experience as are the works of peace. Such, for example, are the bridges developed by our Army, a subject which will shortly have full and adequate treatment in this journal.

Under-Maintaining the Railroads

TO THE engineer there is hardly a more important phase of the present railroad situation than the status of maintenance of the physical plant, under Federal control. It is now generally known that maintenance is seriously below normal. An able analysis of the conditions is presented in this issue, in an article by a railroad executive.

The Federal-control act provides that the properties shall be returned to their owners in substantially as good repair and complete equipment as they were received by the Government on Jan. 1, 1918. Since the Government assumed control on short notice, a detailed survey of actual physical conditions was not possible, so that it is necessary to consider expenditures for maintenance during the three-year "test period" as a basis of comparison. On account of the advance in the cost of labor and materials, items of expenditure must be equated to cover the relative costs of renewal and repair during Government control as compared with the test period. Thus we arrive at a comparison of rates of expenditure equated as to cost.

The facts and figures given are worthy of the most serious consideration. A considerable "deficit" exists in the maintenance of the lines under Federal control, both in track and equipment. Unless this deficit is made up and the rate of renewal increased to the old standard, our transportation system—and, consequently, the service which it renders—will be seriously impaired. The deficit must be made up whether the roads are returned to private operation or not. In other words, a physical condition is here the question, not a matter of financing or ownership.

While war conditions naturally shut off a large portion of the supply of renewal materials, these conditions have not existed since the armistice, and yet renewals have not been materially increased. It is true that in some cases, and in particular in the case of ties, large material contractors were driven out of the market by the rules and specifications of the Railroad Administration, so that some time might have been required in reëstablishing a normal source of supply. But it appears that no effective measures have as yet been taken in this direction.

Since the country is already under-supplied with transportation, the situation calls for immediate and vigorous action on the part of the Railroad Administration and, if need be, by Congress, in providing the necessary appropriations to make up the existing deficit in the maintenance of the roads.

Integrating the Architectural Profession—An Example for Engineers

IT HAS not been lost on engineers that the architects have had marked success in organizing for their own welfare and the service of the public. They have (in the American Institute of Architects) a code of ethics "with teeth"; they have standardized, and secured general adoption of, a procedure for architectural competitions; they have had a large degree of recognition in the formulation of public building policies and in the drafting of building codes, and they have put through in many states laws covering the practice of their profession. Because their organizations have been so effective, a new organization step they are taking is of special interest.

There has just been formed in New York State—*leading members of the American Institute of Architects taking an active part therein*—the New York State Association of Architects, a body which aims to include the *entire profession* in the state and which will devote its energies to improving the status of the architect. It will admit to its ranks not merely the architect in independent practice and the employed architect, but the draftsmen as well. There is to be no breaking up into classes. When the interests of the whole profession are at stake, all are to work together, employer and employed.

In engineering lines we have a somewhat similar movement—the American Association of Engineers—but with this very important difference, that it was not started, nor is it now supported, by the leaders of the profession. The latter, through the founder societies, are supporters of Engineering Council.

But, comparing the new movement with either the American Association of Engineers or Engineering Council, there is another distinct point of difference. The purpose of the association is to be broadly construed. It is to look after legislation for the interests of the profession—and to that end large membership will be of material help; it is to undertake "welfare" work, and, strange as it may sound to engineering ears, accustomed now to the advocacy of the separation of technical from civic and welfare activities, it is to undertake technical work. There are two reasons for the inclusion of the technical: To assist in the education of those who are not members of or eligible to membership in the institute, and to help the architects in the smaller communities in the solution of their problems.

Curious it will sound to engineers, too, to learn that the institute is not affrighted by the new organization but actually is encouraging the formation of similar associations in other states. It goes even farther; it asks that delegates from such state organizations be sent to the institute's conventions—with the evident purpose of coördination and coöperation. With the members of the institute acting as leaders in the state associations, that body will inevitably be the federating agency for all architectural activity.

Plunged deeply just now in the problem of professional reorganization, engineers may well draw inspiration from the breadth of vision displayed by the architects. When the conference committee of the development committees reports, we are sure to have before us a plan for the integration of the engineering profession. In that time may we have the vision of the architects, that, seeing the great purposes of the plan—assuming that it is adequate—we may brush aside minor difficulties and quickly put it into effect!

Concrete Under Repeated Stress

FEW structures of concrete are subjected to stresses of highly variable intensity. The nature of the service to which concrete is ordinarily applied is responsible for this fact, rather than any hesitancy on the part of engineers. No reason exists for doubting the permanence of structures exposed to nothing beyond the commonly used working stresses, though they be stressed a very great number of times in succession; and this fact may be stated just as confidently for concrete as for steel. But while for steel we have favorable positive evidence to support the statement just made, we lack such support in the case of concrete. New uses of the material are likely to change this state of affairs by supplying either favorable or unfavorable evidence, and we may soon have need for the knowledge furnished by facts of that kind.

Alternating stresses occur in pronounced form in the framework of a ship. As measurements made by engineers of the Emergency Fleet Corporation show, the stresses in, say, the deck of a concrete ship are just as continuously varying as those in a steel ship. Each wave that the vessel rides bends the ship's structure first upward and then downward, reversing the stresses by virtue of which the ship resists the bending. And these stresses are of respectable magnitude. Since the continuity of wave action in rough weather adds up the number of alternations rather rapidly, service experience should be available in relatively short time to tell of the deterioration, or the opposite, of reinforced concrete in this unusual stress-service.

Railway bridge service involves stress repetition, but in less intense form. Numerous concrete viaducts of the trestle type exist on our railroads, but in general the material of which they are made is exposed only to a unidirectional stress range, and this of moderate amount. When concrete is applied to elevated-railway structures in rapid-transit service, however, a high range of stress variation is likely to be involved, and probably reversals (in the rigid-frame type of column-and-girder structure); and the number of stress repetitions or reversals will mount up very much more rapidly than in ordinary railway viaducts. For the design of such structures there should be opportunity to obtain most valuable guide indications from the service of concrete in ships.

As to the nature of the destructive action resulting from repetition or reversal of relatively high stress—the so-called fatigue—we have no knowledge. For steel we know that it does occur, and there are some hypotheses as to its cause, but there our knowledge ends. We do not know even that it occurs in concrete, except perhaps for indications given by a few experiments in connection with the ship studies. However, the engineer's attitude is likely to be that, if a strong and tough material like steel is injured by high-stress repetition, then cement, a brittle material, must surely be held to be affected in similar manner. Until more exact knowledge is forthcoming, practical design will probably be controlled by such an assumption.

Direct transfer to concrete of the impact-allowance method used for steel-bridge design involves two points worth notice, however. By the impact-allowance method the action is regarded in effect as a load increase, in place of a strength decrease. It is an easy step to the conclusion that the "impact" of the load represents the same increase, whether concrete or steel be the structural material; or perhaps less for concrete on account of its greater weight. Yet the fact is that we have no reason whatever to assume that the strength decrease due to repetition or reversal (if effective at moderate stresses) may not be much greater for concrete than for steel. Caution in the use of impact allowances therefore seems advisable, so long as we combine in a single process the allowances for true increase of load-effect (i.e., true impact) and for stress repetition.

How far the question of localized stress concentration enters the problem of repetition effect is another important factor of uncertainty. Broadly viewed, steel may be regarded as a highly homogeneous substance, at least when compared with concrete. But there can be no doubt that in reinforced concrete, where there is transfer of stress between steel and matrix throughout the stressed body, local stress concentration must play a determining part in repetition or reversal effect. So far as the Fleet Corporation experiments have gone, they have pointed toward this conclusion, in fact.

Judgment will of necessity be resorted to in deciding upon the proper treatment of this subject in concrete design. For the reasons indicated, however, it is suggested that care needs to be used in taking over the methods used in steel designing, without careful scrutiny of the actions they are meant to cover and the peculiarities of the two materials.

What Has New York State Received for Its $100,000,000 Highway Expenditures?

Analysis of Work Done During 21-Year Period, 1898-1919, Shows Economic Fallacy of Increasing Mileage With Nondurable Types of Construction Involving High Maintenance Costs

By H. Eltinge Breed

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SINCE 1898, when it made the first appropriation for $50,000, New York State has spent $99,300,000 for new roads. Since 1909, when the figures were first available, it has spent $30,327,995.06 for maintenance and repair, a total expenditure of over $130,000,000.

What have we for it? Briefly, 7181 miles of improved road, Jan. 1, 1919, and eight through routes traversing the state.

That may satisfy the unthinking, but it challenges the attention of the road builder. He would have us express the result in terms of permanent construction features, such as alignment, drainage, culverts and bridges, foundation, and the dollar values of what we have left in surfacing. He would scan the temporary features, the semi-durable pavements, the snow fences and the like, and their maintenance charges. He would be interested in the organization of our highway department and its engineering costs. And, as indirect results of the highway movement, he would know what can be gaged in respect to its effects upon land values, upon traffic, and upon public wealth. Such questions it is the purpose of this paper to answer, as far as the definite facts at our disposal will permit. We collate the facts now because we believe it is the psychological moment for their consideration.

Total Expenditure $130,000,000

The $130,000,000 that New York State has already expended is only a drop in the bucket of moneys that will be poured forth throughout the country upon highways in the next ten years. From its last bond issue, plus the share to be contributed by towns and counties, New York has still available for new roads $24,800,000. Add to this $490,000,000 appropriated or pending appropriation by various other states; $200,000,000 of Federal aid, to be doubled by the states using it; and further contributions by counties and towns, and the total is almost $1,000,000,000 for good roads. So urgent is the need to expedite the work upon the roads, so apparently ample are the funds, that we are inclined to gallop ahead with the same rash expenditure that characterized war-time necessities—with a "Build a Road at any Price" slogan. But wisdom should moderate haste while we formulate the results we desire and the best methods of obtaining them. Now is the time to think in terms of economy; to remember that, after all, a billion is a billion, that each dollar of it wasted is so many feet less of good road; that highways are constructive and not destructive, and that we need every mile of them we can stretch out of the money, to help reduce the national debt.

Because New York State was among the pioneers in highway work—its first roads having just come of age—its experience should be a warning against much foolish and extravagant practice, and an index to certain satisfactory results.

In all that follows, the writer would emphasize that the scope of this article is the whole 21 years, and that no administrations, much less any individuals, are subject for special praise or censure. Where success has been achieved, it has been through zeal for public welfare and the good-roads movement, through vigorous, hard work, honesty and efficiency, and through application of the scientific spirit to every practical detail. Failures have occurred sometimes through errors of judgment inevitable in the experimental stage of any work; often through shortness of vision in anticipating needs of the future. Where fraud, extravagance and superficiality have been deliberate there is less occasion to pillory the offenders than to blame the public conscience which condones the offences. Just so long as the public permits its great works to be matter of partisan politics, just so long it will have to tolerate methods and results that would be scorned by any reputable private enterprise. When the public holds its workers to a high standard of ethics and demands strength and soundness in their work instead of speed and show, then it will get value commensurate with expenditure. Whatever blame falls is not upon administrations, but upon the public conscience back of them.

Let us first consider what proportion of the $130,000,000 was expended upon permanent construction features and how.

Surfacing

Starting at the top, because surfacing is the obvious part of a road, we have built a total of 8506 miles of *pavement*, of which there exist to-day 6912 (269 miles built in 1918 not included.) We have lost 1594 miles, or 19%. The following table, dated Jan. 1, 1918, shows the number of miles that were originally constructed of each type and the number that have had to be reconstructed:

TABLE I. EXISTING AND RECONSTRUCTED MILEAGE AS OF JANUARY 1, 1918

	Mileage Now Existing	Mileage that Had to Be Reconstructed	Total of Miles Built
Gravel and water-bound macadam (gravel 125 miles)	2248	1402	3650
Bituminous macadam, penetration method	3346	120	3466
Second-class concrete (carpet top)	163	53	216
Roemac and rock asphalt	29	10	39
Bituminous macadam (mixing method) on macadam	37	6	43
Brick	552	3	555
Cement concrete	408	....	408
Bituminous macadam (mixing method) on concrete	63	....	63
Stone block	22	....	22
Bitulithic	16	....	16
Sheet-asphalt	15	....	15
Asphalt-block	13	....	13
Total	6912	1594	8506

Putting it conversely, in order to retain possession of the 6912 miles of pavement we have had to build 1594 additional miles. In dollars those miles today, of the same type of pavement, would represent $13,400,000, a heavy charge against our investment.

Increase of traffic aggravates the condition on the older semi-durable pavements. In 1916 we had to resurface or reconstruct 202 miles; in 1917, 238 miles.

The table justifies some comment.

Gravel roads, of course, are expensive today for such heavy traffic as the good-roads movement has developed in New York State and is developing throughout the United States. They were built five to twenty years

ago to sustain horse-drawn traffic. With a surface treatment they may be used for light motor traffic up to about 400 tons a day during the seasons of soil stability.

The water-bound roads were designed for loads of from one to five tons. They have been shattered by the heavier, motor-driven loads. As such loads are inevitable upon any improved road, the use of water-bound macadam should be confined to isolated places and to spur lines and feeder routes where the prospective traffic will not exceed 800 tons a day for the next six years. Even then, water-bound roads must be surface-treated and built with the utmost care. Their low first cost, under present average traffic conditions, is offset within five years by high maintenance and reconstruction costs.

Bituminous-macadam penetration-method roads are disrupted by the pounding and impact of heavy vehicles because of the mobility of the crust when it is not sufficiently thick. To build the crust so that it will sustain heavy traffic increases the cost of the pavement to that of a durable type, its disadvantage then being higher maintenance charges. The average life of the bituminous macadam is slightly longer than that of the surface-treated water-bound.

Second-Class Concrete Discarded

The second-class concrete is now entirely discarded in favor of first-class, having been only a feeler toward the better article. New York's experience with this older type has been costly—more than $1000 per mile per year for maintenance and upkeep.

Rocmac and rock asphalt have proved generally unsatisfactory for the traffic conditions to which they have been subjected.

Bituminous macadam, mixed-method, on macadam foundation, has not given such good results for the cost involved as it has when placed on concrete.

The success of brick pavement and of bituminous macadam, mixed-method, depends upon proper foundation, skilled selection of materials and great care in construction. Brick laid in towns and villages and wherever the drainage is thorough has been very satisfactory. The three miles that had to be relaid contained poor brick, were built on a poor foundation and used a sand cushion, which best practice now discards in favor of the cement-sand (motor-bed) or the monolithic type.

The pavements on which no reconstruction had to be done were cement-concrete, stone-block, sheet-asphalt, asphalt-block, bituminous macadam, mixed-method, on concrete, and bitulithic.

The bituminous macadam, mixed-method, on concrete having been laid only in the past few years on New York State highways, has not yet had the chance fully to prove itself under hard service with heavy truck traffic. All present indications are in its favor. The other types in this group, which, with the brick we classify as permanent, have demonstrated their endurance not only in New York State but wherever they have been laid throughout the country.

Table I indicated the relative permanence of the various types of pavement in New York State. The following tables indicate relative costs. Columns 2, 3 and 4 of Table II give the average cost of building each type in New York State in 1915 (our last stable figures before the war-time inflation) which, multiplied by the total miles of that type, indicates what our roads would have cost in 1915. Today, of course, they would cost far more; during the years when most of them were actually built they cost far less.

TABLE II. FIRST COST (BASED ON 1915 PRICES), MAINTENANCE COSTS AND "REAL" COST (INCLUDING MAINTENANCE AND RESURFACING)

	First Costs (Estimated on Basics of 1915 Price			Maintenance Cost for Entire Roadway			Real Cost of Pavement
					Average Cost per Mile per Year		
Type	Average Costs per Mile	No. of Miles	*Approximate Worth if Built at 1915 Prices	Miles Maintained	1915-1918, Maintenance and Resurfacing	1916-1917, Including Reconstruction to a More Permanent Surface	Over 5-Year Period, Including Maintenance and Resurfacing
Column Number	2	3	4	5	6	7	8
Bituminous penetration	$13,000	3,346	$43,498,000	2,793	$490	$505	$15,450
Gravel	7,500	125	937,500	173	843	1,246	11,715
Water-bound macadam	10,250	2,123	21,760,750	2,451	911	1,063	14,805
Brick	25,000	552	13,800,000	284	210	.....	26,050
Cement concrete	15,300	408	6,242,400	208	138	.....	15,990
Second-class concrete	13,200	163	2,151,600	291	938	.....	17,890
Stone-block	37,000	22	814,000	.....	.....	.....	.....
Mixing-method, bituminous on concrete	20,000	63	1,260,000	89†	356†	.....	.....
Mixing-method, bituminous on macadam	17,000	37	629,000				
Rocmac and rock asphalt	16,100	29	466,900				
Bitulithic	29,400	16	470,400				
Sheet-asphalt	30,000	15	450,000				
Asphalt-block	25,100	13	326,300				
Totals		6912	92,806,850				
Miles built in 1918 and accepted	269 at $13,700		$3,685,300				
Miles built in 1918 too late for acceptance, (94 at $13,700) 85% estimated as paid,			1,094,630				
Miles built in 1918 on existing contracts, (279 at $13,700) 80% paid			3,057,840				
			$100,644,620				

Remarks: Figures for all types of fewer than 50 miles have not been extended because of possible injustices in striking small averages.

* Estimated on basis of 16 ft.-wide, 6-in. thick pavement, where the foundation is of broken stone; where the foundation is of concrete it is estimated as 5-in. thick. Many roads are narrower, a few are thicker. This seemed a fair average.

† For all types of mixed-bituminous, both on macadam and concrete bases.

These cost data are significant merely as suggesting how the $130,000,000 was spent. The value that we have today from that expenditure is quite a different matter.

Columns 5, 6 and 7 explain themselves. Maintenance figures are given for the past four years because the roads then are the culmination of the policies of all the preceding years. Comparing column 6 with column 2, we see that high maintenance cost goes with low first cost. Estimating the *real* cost of the pavement, column 8, for a period of five years, by adding to first cost the cost of maintenance each year, we find that cement concrete takes the lead for permanent low cost, with brick a fair second and bituminous macadam, mixed-method, coming in third. This, be it remembered, only in respect to cost. Other considerations that help to determine the choice of a pavement might quickly destroy this order. Moreover, even in respect to cost it must be remembered that the figures given are averages of *every* road under maintenance throughout the state. They do not tell the entire truth, because they fail to discriminate between the cost of roads built suitably for the traffic they must sustain, and those not so built. For instance, the average cost of water-bound and bituminous macadam, including that on light-traffic roads, might not lead one to suspect their almost prohibitive maintenance on through routes for heavy traffic. The following is an illustration:

The X-Y road was built in 1908 as a 7 and 8-in. water-bound macadam, 5.14 miles long, at a cost of $59,500. Maintenance and repair for the first three years was $24,555.11. Then, in 1912 and 1913, it had to be resurfaced, and a 3-in. bituminous-macadam penetration-method top was used. The cost of resurfacing and maintenance from 1912-1919 has been $81,093.05, making the total cost of that road to date $165,148.16, and we still have only 5.14 miles of an impermanent type that requires an immediate expenditure of another $8000 to make it fit for traffic.

What New York State's experience proves, in the above tables, is the utter waste and folly of building miles upon miles of cheap pavement to fatten political "pork." A road is not the possession of one village or of one boss. It belongs to the whole country and should be built for the welfare of the whole country, regardless of local rivalries. Every weak link threatens the entire chain of communication and checks the flow of economical transportation. The tables show that there is rarely a sound economic reason for building cheap, impermanent types of pavement. When there is such a reason, let it dominate. Otherwise, in the spending of that billion, let us build for permanence. And may the people be taught to demand permanence in their roads—for upon the people rest the ultimate cost and the ultimate responsibility.

Had New York State followed from the beginning the policy that experience has since taught, we should now have almost all of those lost 1594 miles and about 400 others (on the basis that the average maintenance, resurfacing and reconstruction cost could have been cut one-third or more by building of better types), whose first cost has been consumed under the old policy by excessive maintenance charges upon impermanent types. That represents a definite money loss of $6,000,000, plus an inestimable loss in the public wealth that accrues from two thousand miles of good roads. Will the people henceforth in the states where the billion is to be expended tolerate such losses? I think not.

Alignment

Pavement is only one factor in the 7181 miles of road that our $130,000,000 has bought us. Part of the money has been spent on alignment. Since 1907, wherever it has been practicable and reasonable in cost, all curves have been widened by the removal of buildings and the grading back of corners to allow at least a 400-ft. sight distance. It has been proved that this is the least distance compatible with safety for motor traffic. Fills have been widened and guard rails eliminated wherever possible. The extent of such improvement is indicated by statistics from 100 miles of pavement. These show that the land takings necessary amounted to 65.4 acres, comprising 226 parcels or rights-of-way: that there were 161 cases of widening; that 53 corners were cut back with curves eased and widened, and that 13 new locations were made to improve grade and alignment.

There has been debate in the department as to the economy of straightening curves and reducing grades. The problem formulates itself thus: The cost of a curve to each vehicle is the amount of fuel necessary to regain the original momentum lost in slowing up for the curve. Multiplying the average amount by the number of vehicles taken by a traffic census during a fixed time, you can approximate the cost of the curve in fuel for one year. If the saving in fuel is greater than 4 per cent of the expenditure necessary to eliminate the curve, then the expenditure is warranted; that is, a saving of $400 would warrant the expenditure of $10,000 for the improvement. I take 4 per cent as the basis of capitalization because of the inevitable increase in traffic. In the past four years almost $200,000 was spent in widening and banking curves. This work can be more cheaply done under first construction.

The economy of lengthening line to save grade is doubtful. The question is: Does the amount of fuel, or motor energy, necessary to climb the grade, exceed the amount that would be consumed by the additional distance traveled over a less grade? The indeterminate factor, which makes even an approximate answer impossible, is the amount of fuel saved on the down-grade. We have simply followed the policy of reducing the distance and grade wherever it was possible, figuring on an estimated basis of the saving to the traffic that will use the road.

Width and Shoulders—Drainage and Foundations

Akin to alignment is width of roads. In 1898 there were few miles of road in the state, outside of the large cities, wider than 12 ft. Now, there are few miles of state road being built narrower than 16 ft. Much of the money contributed by towns and counties has been expended in additional width of road from 2 to 8 ft. Almost all new roads since 1915 have had specified widths of from 16 to 20 ft. During these four years approximately $300,000 has been spent in widening old roads, yet, notwithstanding this fact, it has been necessary to spend large amounts of maintenance money to keep up the shoulders on heavily used roads. The necessity has been forced upon us by increase in traffic. An improved road that is also a narrow road is a menace. It attracts to itself more traffic than it can accommodate, and resulting wrecks strew its shoulders. No main highway should be designed less than 20 ft. for pavement surface and 32 ft. between ditches. Subsidiary roads should be at least 16 ft., with shoulders extended to 26 ft., and curves widened from 4 to 8 ft. for safety. All highways when built should be designed so as readily to permit additional widening. This, especially in the 16-ft. road, should be a factor in the choice of pavement. Had our roads been designed of adequate width and so as to be easily widened, the state would have been saved much money. Now that it has been shown by numerous traffic censuses that any improved road attracts to itself approximately 200 per cent. increase in traffic during the first year after its completion, there is no excuse for new roads narrower than 16 ft., or for any incapable of being widened.

In design, construction and maintenance, shoulders have been too much regarded as distinct from pavement proper. They are an integral part of the width of the roadway, and crumbling or unstable shoulders very soon mean disintegrating pavements. They should be built to sustain a proportionate part of the loading for which the road is designed.

Of the money expended for drainage, much has been wasted and lost, primarily through inadequate design. It is impossible to determine exactly the total loss in dollars upon this one feature of our highway work, because in any loss of pavement that occurs the blame must be divided indeterminately between crust and

drainage. By an inspection made in 1916 of 4733 miles of road to ascertain the cause of 758,000 sq. yd. of breakups, equivalent to 83 miles of 16-ft. pavement, defective drainage was discovered in 50 per cent. of the cases. The worst defects were due to inadequate design, insufficient foundation, lack of proper inspection and ignorance of soil conditions. The ground that to the uninitiated seems beautifully stable in July may become a quagmire in November, April and May. It requires an expert, trained in practical soil and foundation conditions, to prescribe the necessary amount of drainage, and he will be more accurate if he receives reports on soil and weather conditions throughout the four seasons and has the opportunity to observe the project after the spring thaws, when the greatest soil instability occurs. Ignorance, carelessness and haste cause faulty inspection; and desire to cheapen the work so as to extend mileage has often been responsible for inadequate design.

Efficient Drainage Needed

Even where design and construction were adequate, failure in drainage was very frequently found through the clogging of drains, ditches and culverts, insufficient outlets, too small an amount of drain areas, etc. This should be prevented for surface drainage by the removal, from the area along the roadway, of obstructive vegetable growth; for subsurface drainage, by keeping the outlets open and by insistence upon patrolmen doing their work. Given drainage that is 90 per cent. efficient, the cost of maintenance along the highways of the future will be so lessened as to make our former figures appear ridiculous.

Foundations are of permanent value. Their shortcomings are visited not upon themselves, but upon the pavements above them. We have 3400 miles of broken-stone foundations averaging 3 in. in depth, or better. These are the roads 6 in. in depth with a 3-in. top and a 3-in. bottom course. We have approximately 1000 miles of durable pavement with a foundation of 5 in. of concrete. Foundations generally have but one defect, the lack of depth which afflicts 3400 or more of our miles. For the purpose for which these miles of road were designed the depth may have been adequate, but it did not anticipate their allurement to traffic. Now the old foundations must be deepened to at least 9 in. to meet the demands upon them. It is cheaper to lay a good foundation once for all than to renew pavements. The rate of development of traffic during the past ten years, and the prospective limitation of loading to the five-ton truck, affords us some standard of measure by which to plan. It is fair to say that no new road, or road to be reconstructed, should be built with a foundation of less than 9 in., if it be of broken stone, and the depth should range from that, according to prospective traffic upon the road, up to 15 in., which is the lowest possible allowance for through routes.

A concrete foundation should be at least 6 in. deep, and should range from that, according to prospective traffic and type of surface selected, up to 9 in. on through routes.

If the sorry choice has to be made, it is better to build a cheap pavement on a good foundation than a good pavement on a poor foundation. But with the money available there should be no occasion for such a choice.

The state has spent $510,000 of its highway money in eliminating grade crossings, representing a total expenditure by the state, counties and railroads of $1,340,000, with a permanent gain in safety to all users of roads. Henceforth, in deciding new location the necessary money should be spent at the start to avoid grade crossings. They are wrong anywhere in these days of traveling at high speed.

One other gain we have in our highways proper which cannot be expressed in money: It is that stability of soil which accrues to a road through years of usage. The firm consolidation, under impact, of even the old earth roads illustrates what I mean. It is like goodwill in a business, inestimable but potent, and it is the possession of nine-tenths of our roads today. In reconstructing or rebuilding a road, the grade, wherever possible, should be high enough to make use of this stability of soil, as it will give greater stability to the new crust or pavement and will many times lessen the amount of drainage necessary.

Adjuncts to the road, such as guard rail, snow fences, signposts and the like, have cost the state approximately $1,259,400 and have a present valuation of $670,200. As in the case of every other factor, we must remember that normal depreciation and even excessive first costs are more than offset today by the abnormal increase in prices since the work was done, and consequently in the present valuation. Maintonance of those factors is a big item. It should be less in the future, when the old painted wooden guard will, in many cases, be eliminated by the lengthening of culverts and broader shoulders, or replaced by the more artistic and serviceable concrete parapet, and when all signposts throughout the country are made simple, and a uniform scheme of banding on poles is adopted such as has given satisfaction in the New England States.

So far we have been talking of *costs*, for which either actual or approximate figures have been given. "Actual" figures are those taken direct from statistics in the Highway Department; "approximate" figures are taken from averages of data collected from many roads in every section of the state. We come now to the debatable estimate of present values.

Present Values

It would be unjust and misleading to formulate in dollars the worth of what we have today, strong as is the temptation to do so. Too many undetermined factors enter into such an appraisal, to give it validity. This much, however, is definite: For our $130,000,000 we have only 1092 miles of durable pavement. The average life of the semi-durable or nondurable types which comprise more than 5820 of our remaining miles is not more than five years, at nominal maintenance. Most of these roads have already passed that age, and are kept in service only through excessive maintenance. That is a poor return for our investment. We can, and must, get far better results from future expenditures. But the depreciation must not blind us to the benefits we have gained. Highways are means to ends, not ends in themselves; although built at exorbitant cost, they have served their purposes well.

They have given to people and products greater freedom of movement. What that has meant in life, liberty and the pursuit of prosperity can be faintly surmised from the howl that goes up whenever a mile of road is shut off for repairs. It cannot be estimated in dollar values.

The highways have enhanced land values wherever they have been built. Farm lands contiguous to improved roads have increased in value from $10 an acre to $30 an acre. In New York State, between 1890 and 1900, the decrease in farm values was approximately $80,000,000. The United States census shows that between 1900 and 1910 there was an increase along improved roads in New York State of $381,758,000 when only $36,200,000 had been spent for improvement. This pertains only to rural districts. The increase in value of land adjacent to cities and towns is apparent as soon as highways are improved. In some parts of Westchester County, which is just north of New York City, land values along improved roads have gone up 200 per cent. within a year after the road was built.

They have helped produce flourishing hotels all over the State. The rundown boarding house of twenty years ago has given place to the enterprising inn of today.

They have encouraged travel. The census of foreign cars, those from other states, taken in New York State in August, 1917, shows 1955 foreign cars in and out of our state daily on four routes. This average would hold up through July, August and September; i.e., 90 days which, multiplied by 978 cars (½ of those in and out) would give 88,020 cars during the season on these four connections. Allowing an average of four passengers to a car, this would mean 352,080 persons coming into the state. At an expenditure of $5 a day apiece—too little, as any tourist knows—that would mean a yearly gross income to the state of $7,041,600 for an average stay of four days. There are nineteen other routes, all bringing tourists. The income from this source shows partly why good roads pay.

Advantages to the farmer from our roads have been expatiated upon—better market facilities, lower freight rates, no idle teams, and so forth and so forth. Certain it is that the banks show a large balance to the credit of New York State's farmers. How much of this is due to improved highways makes interesting speculation.

We might have had more and better highways for our money; in many cases we should have had them. Yet our investment has probably added proportionately as much to the welfare of the state and its people as any other amount expended hitherto upon public works.

Unloading Refuse Trailers by Net and Pole

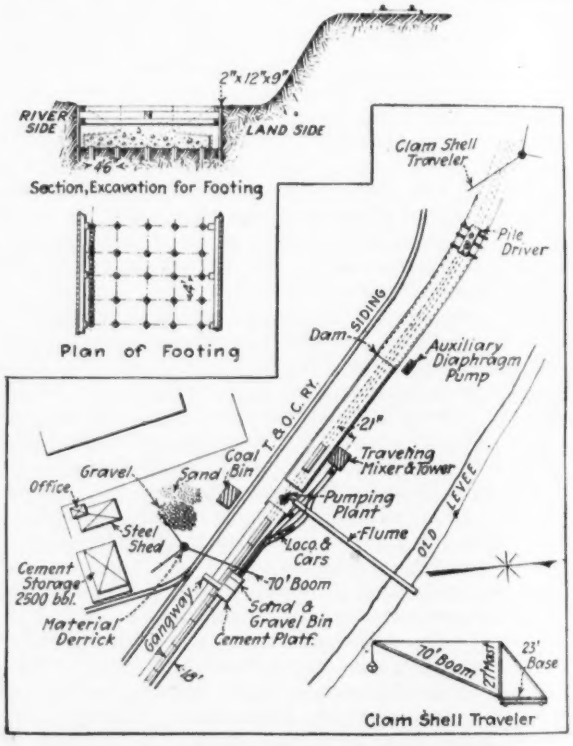
Quick unloading of garbage and refuse trailers at Calgary, Canada, is effected by means of a net and pole. The mixed refuse, after being collected in 2½-yd. two-wheeled carts drawn by one horse, is hauled to loading stations and dumped into electric motor-drawn trailers of 18-cu.yd. capacity. The trailer bodies are 8 x 4 x 18 ft. Before the refuse is dumped into them, a rope net is spread over the bottom and up the sides. When the trailer arrives at the incinerator the net is pulled together at the top, a pole is run through it, lengthwise of the trailer, a hook and cable are attached to the center of the pole, the side of the trailer body is let down, and the whole load is hauled out and dumped into the receiving pit. Power is applied either from a drum or by manipulating the clamshell bucket used to move the stored garbage from the pit to the incinerator. A trailer can be emptied in 2 or 3 min. Three or four trailers are hauled by one motor truck, conditions permitting. J. J. Dunn is chief sanitary inspector.

Concrete Wall Construction Is Continuous Process

Trenching, Sheeting and Bracing, Piledriving, Form-Setting and Concreting Outfits Move in Procession

A PROCESSION of operations each self-contained and all in step is putting speed into high concrete wall construction at Columbus, Ohio. Wall 25 ft. high and running a little less than 5¼ cu.yd. per foot is being completed at a rate of 76 ft. per week. In an occasional week 20 ft. additional has been completed. This progress includes excavation, sheeting and bracing and piledriving, besides wall construction proper. Measured by volume, the usual week's work is 400 cu.yd. of wall completed.

North of Broad St., Columbus, Ohio, on the southwest bank of the Scioto River, the earth levee of the new flood channel is replaced for 1200 ft. by a heavy reinforced-concrete wall. Except at the ends where the wall forms



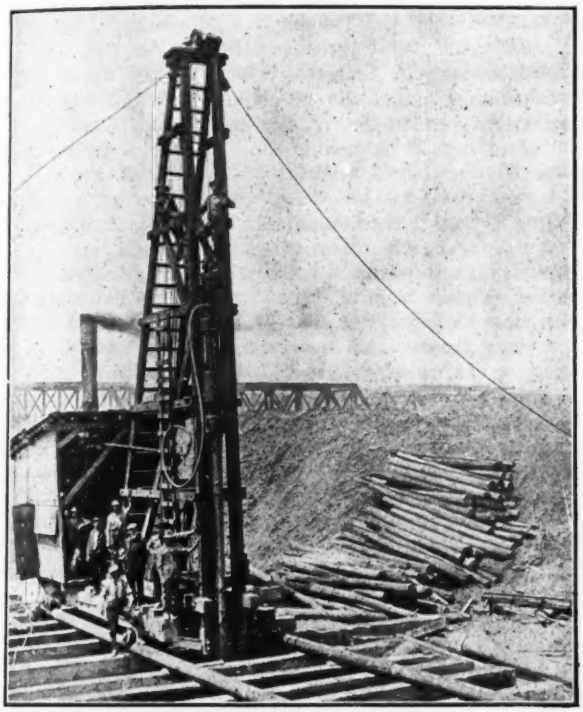
TRAVELING PLANT IS EMPLOYED FOR CONSTRUCTING CONCRETE WALL

into bridge abutments and where it is 30 ft. high, the wall is 21½ ft. high on a footing 21 ft. wide. The rear face of the wall has a batter of 1 in. per foot and the front face is vertically curved to a radius of 74 ft.; its width over the coping is 2½ ft., and under the coping overhang is 2 ft.; it is 7 ft. through at the footing, which is 21 ft. wide, 3½ ft. thick at the wall which stands in the center and 2½ ft. thick at the edges. Piles spaced 4½ ft. across the wall and 4 ft. longitudinally carry the footing.

Construction involves none except the usual wall-building operations: Trench excavation, sheeting and bracing, piledriving, form building and concreting. Its

exceptional feature is the train of equipment for performing the several operations in sequence and the coordination of these operations so that they advance in order and at the same speed. The various plant units and their arrangement are shown by the diagram plan and the views.

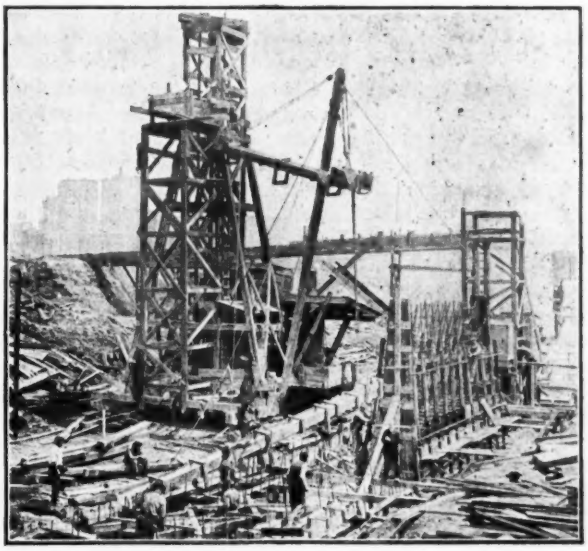
The first unit of the plant is a stiff-leg on four wheels which travels on a track at one side of the trench location. Equipped with a three-drum, 7 x 10-in. hoist and a rotary swinging engine, this traveler operates a ½-cu.yd. clamshell for trench excavation, and with the bucket removed places the bracing. The bracing carried forward dismantled from where the footing has been completed is assembled just ahead of the digging, and as the trench is made ready the assembled units are lifted and set in place by the traveler. The trench is carried down only about seven feet and is sheeted.



PILEDRIVER FOR CONCRETE WALL CONSTRUCTION HAS TRANSVERSE AND LONGITUDINAL MOVEMENT

All piledriving is done through the bracing, which causes some annoyance in the handling of the long sticks but is not seriously troublesome. The driver has 39-ft. leads, a two-drum, 6 x 8-in. engine and a No. 2 steam hammer. Travel across track is on pipe rollers on transverse track timbers and along trench by spool-rollers on the pipe rollers. When the piles are driven and sawed off, the footing forms are set. The lower rangers and cross-braces of the bracing frames are taken out, and the forms are hung from the top cross-braces, as is indicated by the dotted lines on the sketch of the trench section.

The concrete is all placed from a traveling mixing plant. First, the footing is poured several sections ahead of the wall itself. Then the wall is built in sections 30 ft. long, using steel forms with wood bulkhead or end forms. One full set of steel forms for a 30-ft. section and posts for another section are provided, the posts for the section ahead being erected and lined up while the form for the preceding section is being poured.

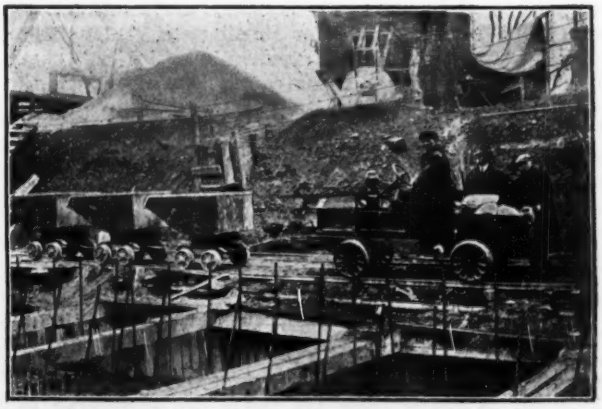


SECTIONS OF WALL CONCRETED FROM TRAVELING TOWER AND CHUTES

When the forms used for the concreted section are taken down, the plates are shifted ahead and fastened to the posts already set while the posts are carried forward and erected for another section. The forms are dismantled and reërected for each section. Considerable trouble is experienced in getting good alignment, particularly of the coping, which is cast in one piece with the wall.

A ½-cu.yd. mixer and a 40-ft. tower mounted on a platform on wheels form the concreting plant. From the tower, chutes lead to the forms; a boom supports the chutes. As indicated by the view, the tower stands at the front of the platform. Behind it stands the mixer, located so that it discharges into the tower hoist bucket and so that its charging skip drops to the ground over the rear edge of the platform.

Cars loaded with proportioned batches at the elevated bins run to the mixing plant and dump directly into the



CONVERTED FORD HAULS MATERIALS CARS TO MIXER

charging skip. A Ford converted into a locomotive hauls the cars in trains of three. When the mixer plant moves ahead, the materials truck is disconnected at the rear of the switch and the disconnected section is pulled ahead with the mixing plant. A section of track inserted in the gap left behind the switch connects the line up again.

The sand bin, which holds 33 cubic yards, and the gravel bin, holding 67 cu.yd., are stationary, and straddle the track so that cars running underneath are charged from bottom gates. A derrick and a clamshell charge the bins from stock piles supplied by motor trucks. Cement is wheeled on runways to the cement platform at the rear of the bins.

About 50 ft. beyond the bins is a stationary pumping plant consisting of a 10 x 12-in. double-suction pump and a 5 x 8-in. centrifugal pump in a housing set in a gap formed by leaving unconcreted two sections of the wall. These pumps draw from a sump and deliver against a 35-ft. head to a flume extending on a trestle to and over the crest of the old levee. The practice is to operate the double suction pump for two hours in the morning to pull down the night's accumulation of water and then keep the work drained by continuous operation of the centrifugal pump. Water flows to the sump in a channel between the edge of the footing and the trench side. At the end of the footing there is a plank dam.

Here the flow of water from the unconcreted trench is lifted over the dam by a portable pumping outfit which consists of a double 4-in. diaphragm pump operated by a 6-hp. gasoline engine. As the footing advances, the dam and the pump are moved ahead.

The contract calls for about 6200 cu.yd. of concrete. The contractor is D. D. McGrath & Sons, Columbus, Ohio, whose superintendent is W. A. Jones. The work is a portion of the Scioto River channel improvement for flood protection at Columbus. Henry Maetzel is city engineer of Columbus and R. H. Simpson is engineer in charge.

Fire Losses in the United States

American cities of 20,000 population and over in which the fire losses exceeded $5 per capita numbered 35 in 1918, compared with 29 in 1917 and with 23 in 1916, according to the latest report of the committee on statistics and origin of fires of the National Board of Fire Underwriters. The range for the 35 cities in 1918 was from $21.74 for Burlington, Vt., to $5.08 for Tulsa, Okla., and the median city in 1918 was Charlotte, N. C., with a per capita loss of $7.34. In 1916 Jersey City headed the list with a per capita loss of $27.71; in 1915, Newport News, Va., $28; and in 1914, Galveston, Tex., with a loss of $33.06 per capita.

For the entire United States, urban and rural, the average per capita fire loss in 1918 was $2.76 and in 1917, $2.42. The excess of 34c. in 1918, the committee states, is not accounted for by the $30,000,000 loss due to forest fires in Minnesota. Further details for the cities of over 20,000 population are given in the July *Quarterly of the National Fire Protection Association*, wherein it is stated that the cities of the size indicated that fail to report their fire losses are increasing in number.

The Newark Garbage-Feeding Contract

By James W. Costello
Engineering Supervisor, Bureau of Street Cleaning and Refuse Collection, Newark, N. J.

EIGHT times the monthly average top price for live killing hogs in Chicago is the price per ton that will be paid the City of Newark, N. J., for its garbage under a contract for disposal by feeding to hogs, awarded on July 3. The contract runs for five years. The contractor is the National Utilization Co., Arthur N. Pierson, president, Woolworth Building, New York City. The city will deliver the garbage to a piggery on the shore of the Passaic River, where it will be weighed. The city agrees to enforce its separation ordinance and to attempt to collect all hotel and restaurant garbage. It is estimated that when full separation is effected the daily collection will be about 100 tons, and that during the summer peak months about 5000 hogs will be fed. The estimated population of Newark is 450,000.

On account of the limited area available at the site of the piggery, which, as stated, is on the Passaic, intensive methods will be employed. The hogs will be housed in unit buildings 100 x 100 ft. in plan, which will accommodate from 800 to 1000 hogs. A double, concrete driveway and feeding floor 24 ft. wide extend through the center of each building, with a gutter on each outer edge next to the pens. The gutters discharge into large grease traps, to prevent solids reaching the sewer. The pens are arranged on either side of the driveway, and have a slight pitch toward the gutters. There are five pens on each side, equipped with an automatic drinking fountain. Each pen opens into a yard 50 ft. deep. The houses are of the sawtooth type, with windows the entire length below the eaves and in the peak.

The collection of all city refuse was done by contract until 1916, when the contractor terminated the contract on the ground that the separation ordinances were not enforced. The collection was then taken over and carried on by municipal forces. In March, 1919, a new ordinance was introduced requiring the separation of ashes, rubbish and garbage. At the present time separation is effective in about 50 per cent. of the city.

A police officer and an inspector are assigned to each district to enforce this ordinance, and the results have been very gratifying. Separation of the refuse in the remainder of the city will be completed about Sept. 15, 1919.

The erection of a reduction plant of a 150-ton capacity was contemplated, but the present cost of building material was considered prohibitive, an estimate received from one company being $750,000, exclusive of the site.

The city has about six square miles of meadow land, and refuse of all classes has formerly been dumped on this land. There is a contract for the salvaging of the material. The city receives $3000 annually for the privilege, and in addition the contractor supplies all labor necessary to keep the dumps and the roads leading thereto in good working condition. It is planned to erect, when separation is completed in the entire city, a utilization plant for rubbish, and when this is realized only ashes will be deposited on the meadow land. The area of the city is 23 square miles.

The "Upkeep" of the Railways Under Federal Control

An Analysis of the Conditions of the Railway Properties Now as Compared With January 1, 1918, When They Were Taken Over by the United States Government

By a Railroad Executive

THE Federal-control act, under which the Government took over the operation of the railways, provides that the Director General shall annually, as nearly as practicable, expend and charge to railway operating expenses, such sums for the maintenance, repair, renewal, retirement and depreciation of the property as may be requisite in order that such property may be returned to the company at the end of Federal control in substantially as good repair, and in substantially as complete equipment, as it was Jan. 1, 1918.

If the annual expenditures and charges for such purposes during the period of Federal control, and the fair distribution thereof over the same period, are equal, in the aggregate (subject to adjustments due to difference in the cost of labor and material, and the extent of use) to the average annual expenditure and charges for such purposes during the "test period," it shall be taken as a full compliance with the obligations of the Government.

The question whether or not the Director General has fulfilled his obligation to maintain the railway properties, as contemplated under the Federal-control act, is at once a vital one. If not, what is the relative condition of the properties *now* as compared with Jan. 1, 1918, and what will be the probable condition when the properties are returned to their owners on Jan. 1, 1920, as directed by the President?

The Government assumed control of the railways, by proclamation of the President, "overnight," so that no time was allowed to make a detailed survey of the actual physical conditions of each element of the properties as of Jan. 1, 1918, and establish a "physical balance sheet." In order, therefore, to determine as accurately as may be whether the physical condition (whatever it may have been on that date) has been adequately maintained, it is necessary to consider the expenditures made in the maintenance, or "upkeep," of the properties during Federal control compared with similar periods during the "test period" (July 1, 1914, to July 1, 1917). Such expenditures must be equated to cover such items as relative costs of labor and material, extent of use, efficiency of labor, quality of material, influence of deferred work on future costs, in order to bring the two periods upon parallel bases for comparison.

Accurate Comparisons Difficult

The problem of determining the equation factor to apply to the "test period" expenditures is a very difficult one. The increase in wages, back-time allowances, overtime penalties and decrease in labor efficiency, account for 100% or more, in the labor costs alone for the year 1918, compared with the average of the test period. The material equation factor is not as high as the labor factor, for the reason that materials from stock were largely used and those were charged out on prices at which such materials were purchased before the present high prices prevailed. But in the replacement of such materials by the Government, in returning the properties to the owners, it will be necessary to pay current market prices for material purchased to make up deficiencies in stock. Therefore, the present material equation factor generally used, and varying from 35% to 60%, is considered too low.

If it were possible in every element of property to determine the actual relative quantity or units of labor and material expended for the two periods under discussion and then to find the difference and apply current prices to the results, the actual over or under expenditure, as the case may be, in each element could be readily ascertained. Such methods can be applied to many of the important items in maintenance of way and structures expenditures, as, for example, rails, ties, ballast, bridges, trestles and culverts, telegraph and telephone lines, buildings, signals and interlocking plants, etc.

The maintenance of equipment, especially as it pertains to freight train cars, is very difficult to determine accurately, for the reason that under Federal control this equipment was "pooled," resulting in "home" or system equipment being largely on foreign lines, so that the extent of the repairs to such equipment could not be definitely determined. It is, however, a well known fact that freight equipment has not been maintained to the same extent during Federal control as it was during the test period, because foreign lines do not spend as much for repairs on foreign equipment as they do on their own. Many roads which had from 60% to 90% of their own cars on their lines during the test period have had the situation reversed, so that from 60% to 90% of foreign cars were on their lines during the Federal-control period.

The experience of some of the larger railway systems as to the relative upkeep of their property under Federal control, as compared with the period under private control, and the condition of the property now as compared with that on Jan. 1, 1918, will indicate generally the situation as applied to the railways as a whole.

Maintenance of Items in Detail

An analysis of the important elements of the property and their relative upkeep and condition will enable one to arrive at a fair conclusion as to the general result:

Rail—During the year 1918 the Director General of Railroads purchased no new rail for the railways under Government control. Normally, from 1,500,000 to 2,000,000 tons of new rail are required annually. The only new rail laid in 1918 was from contracts made by the corporations previous to Federal control, and the total amount laid in 1918 is approximately one-half the normal requirements. The only new rail contracted for by the Director General for 1919, thus far, is 200,000 tons. The maintenance of rail on branch lines, where relieved rail from main lines is usually placed, has been correspondingly deferred, owing to the failure to provide new rail.

The reasons for the failure to supply the requisite quantity of rail for normal maintenance during 1918 was the necessity for using steel primarily for war purposes, a good and sufficient reason. But upon the signing of the armistice, in November, 1918, there was no good reason why the rail deficiency existing should

not have been made up—at least in part—and large orders for new rail immediately placed. Not only has this not been done, but only about *one-tenth* of the annual quantity of rail required has thus far been ordered for 1919.

There is perhaps no element of property which has deteriorated to a greater extent than the rail, the most important item which goes to make up a good railroad. The prospects are that at the end of Federal control the railways will be from 18 months to two years behind in their normal rail requirements—equivalent to 2,000,000 to 3,000,000 tons of new rail.

Ties—Tie renewals have not been maintained during Federal control. The deficiency in maintenance of this item will range on an average of 30% to 40% in 1918 for the railways under Federal control. This deficiency is due to several causes, among which are changing of specifications, methods of inspection, payment for ties, and a centralization of control for the purchase and distribution of ties, contrary to the long established practices in effect on railways in various parts of the country.

Tie Contractors Driven out of Market

The large tie contractors who have for years been the main factors in supplying the railways with their annual tie requirements turned their attention to the production of other forest products, after failing to obtain from the Railroad Administration a modification of the rules and regulations which the latter sought to enforce, as against the practicable methods long in use.

There has been a large reduction, under Federal control, in the supply of treated ties, due in part to failure to obtain ties for treatment in time for proper seasoning, also in part to the inability to obtain the necessary supply of creosote oil. The zinc-chloride process has been utilized to a certain extent to make up the deficiency in the creosote treatment, but this process will not furnish protection in the more moist and humid climates to equal the former practice of the use of creosoted ties. The quality, therefore, as well as the quantity of ties, has depreciated. Taking this into consideration, the tie condition under Federal control will be placed at about 40% as compared with the test period.

Some of the larger railway systems usually carried a sufficient supply of ties for two years' requirements; i. e., on Jan. 1, 1919, the ties required for 1920 would be on hand, ready for seasoning and treatment. On a number of such roads, on Jan. 1, 1919, there was on hand as little as 25% of the ties required for the year 1919 alone. This will indicate the extent to which the tie stocks have been depleted.

The situation with respect to switch ties and side-track ties is even more critical. During 1918, on most roads very few switch ties and side-track ties were supplied, the needs of main tracks being properly first considered.

At the close of Federal control Jan. 1, 1920, the tie situation will be such that the railways as a whole will be about one year's renewals behind in normal tie requirements.

Other Track Material—This item embraces frogs, switches, crossings, guard rails, angle bars, tie-plates, track bolts and spikes and other track equipment. The deficiency in the supply of material of this character during 1918 was due principally to the absorption of steel for war purposes. This condition, however, ceased with the signing of the armistice, and no effort has been made since to place orders and secure the necessary supply of such material.

On typical roads the deficiency in maintenance of this item will amount to about 40%, as compared with the average of the test period.

Ballast—The annual requirement for repair ballast, as distinguished from new ballasting, is a considerable item, and is necessary properly to maintain track conditions as to surface and line and prevent deterioration of rails, ties and other track fixtures. During 1918 ballast conditions have not been maintained to the same extent as during the test period, there being a deficiency of about 30% on typical important railways.

Bridges, Trestles and Culverts—During 1918 the renewal of steel bridges was necessarily deferred, owing to the difficulty of obtaining material which was primarily absorbed for war uses, so that there has been an accumulation of work of this character. During 1919 twice the average annual program should have been carried out to make up the deficiency of 1918. No effort has been made to accomplish this, and in regard to the renewal of steel bridges the roads will return to private operation, at the end of 1919, at least one year, and on some roads probably more, behind in the maintenance of this item.

In the item of wooden bridges and trestles the year 1918 shows a deficiency of from 40% to 50% on typical roads, which is due to the inability to obtain material during the early part of 1918. The necessary effort has not been put forth to make up this deficiency. It is evident that the deficient maintenance in this item at the end of Federal control will amount to 30% to 40% of the average of the test period.

Buildings—Under Federal control there has not been the amount of new construction of buildings replacing old structures that obtained under private control, and the repairs to buildings generally have not been as extensive as under private operation. There is a deficiency of maintenance of buildings of all classes of approximately 25 per cent.

Upkeep of Equipment—The upkeep of equipment under Federal control as compared with the test period is very difficult of exact determination, particularly with respect to freight train car equipment, for the reason that under Federal control this class of equipment has been "pooled," and the payment of per diem for the use of freight cars was discontinued on July 1, 1918; this has resulted in "home" cars being on foreign lines, up to as high as 85% to 90% of a road's ownership.

"Foreign" Equipment Under-Maintained

The effect of this situation has been that the repair or maintenance of cars owned by a particular company while such cars were on "foreign" lines has been neglected, because in many instances the necessary material for such cars was not available. Also, foreign roads have no interest in the ownership—and therefore the condition of such foreign cars—and only the absolutely necessary repairs have been made to keep them moving. There has also been a change made in the method of charging for certain repairs of cars while on foreign roads, which expense must now be borne by

the foreign roads, while formerly such repairs were chargeable to the owning roads. Naturally, under this method foreign roads make the minimum repairs, to reduce operating costs.

Another element which affects the maintenance of equipment under Federal control is the reduction in the efficiency of labor as compared with that in corporate operation. The system of car repairs on the "piecework" basis, which was largely in effect under private control on most roads, has been entirely abolished under Federal control, owing to concessions made to labor organizations. This has not only reduced the efficiency of labor but has tremendously increased the cost of repairs per unit, which has resulted in a cost, on certain items, two to three hundred per cent greater than that which prevailed on the piecework basis.

Labor Inefficiency and High Costs

The practice of permitting certain classified repairs to equipment to be made by particular employees only has greatly increased the cost of the work and has reduced the efficiency of labor. As an illustration, where formerly one employee and a helper have performed a particular piece of work, such as taking down and setting up a "nozzle" in a locomotive, it will now require as many as six different classes of employees to perform such work. This practice has also resulted in poorer work, as it is difficult to place the responsibility for defective work where so many men are engaged upon it.

Locomotive equipment has been maintained in better condition under Federal control than any other class. This equipment has been kept on home roads and, except in particular instances, the previous practice of maintaining it has been continued. There has however, been a very large expenditure for labor-saving appliances, such as mechanical stokers, power grate shakers, reverse gears and other appliances which save the labor of engine crews without adding any efficiency to the locomotive. These items have added to the cost of maintenance of locomotives.

The maintenance of passenger cars under Federal control has not been kept up to the standard of the test period, because, owing to troop movements and the heavy passenger traffic due to war activity, passenger equipment has not received the usual general repairs which were customary under private control on account of its intensive use. The repairs to passenger equipment are behind about 25% as compared with the test period; with the reduction in troop movements it would be possible between now and the end of Federal control, Jan. 1, 1920, to make up a large part of this deficiency in maintenance if the proper effort and plans were made.

In the item of freight train car maintenance it is estimated that for the year 1918 the deficiency is from 30% to 40% on typical railways. On such freight cars as have been on foreign lines the amount expended for freight-car maintenance is about one-half that which has been expended on cars which were on home roads. With 70% to 85% of freight cars away from home, the extent to which freight-car equipment has been undermaintained can be readily estimated. It is estimated that at the end of Federal control the maintenance of freight cars will be nearly one year behind the usual program.

The deficiency in maintenance of the property of the railways during the larger part of 1918 was in part justified by war conditions such as the inability to get necessary materials, the shortage of labor and the intensive use of the plant, making usual repairs impracticable in many instances.

On the signing of the armistice, Nov. 11, 1918, this condition, however, was changed, and it would have been possible to make good this deficiency in many items. The whole deficiency could have been made up by the end of Federal control, by a proper program and with due regard to the necessities of the case.

The policy adopted by the United States Railroad Administration will not return the roads to their owners with the same maintenance expended upon them during the period of Federal control as during the test period. On the contrary, there is a policy to return them in an under-maintained condition, so that the administration will owe the railway companies for undermaintenance, rather than that a balance will be due the administration for overmaintenance. It is believed that this is an unfortunate policy and against the public interest. The public must depend upon the railways for adequate service to meet the ever-increasing demands.

The very least that should have been done was to return the properties in as good condition and with as complete equipment as when the roads were taken over by the Government, as contemplated under the Federal control act.

Deferred maintenance is a very delusive matter. It will cost the corporations two dollars in many cases to make good one dollar of deferred maintenance, if their properties are returned to them in a depleted condition. It will also make it impossible for the corporations to fulfill their proper functions when the roads are turned back to private control, and it will be years before the deficiency in maintenance, as well as the disorganization, is made good. The country has paid dearly for its experience in Government control and railway operation, but if it will save the country from the greater peril of Government ownership the public in the end will have profited by the experience.

Water-Works Rates and Meters in Kansas

Data concerning water rates and the use, ownership and maintenance of water meters in Kansas municipalities are presented and summarized by F. M. Veatch, acting engineer, Kansas State Board of Health, in a recent issue of *Kansas Municipalities*, published at Lawrence. Requests for information were sent to 213 superintendents. Of these 113 replied — 102 for municipally owned and 11 for privately owned works. Within the past five years 43.5% of the 113 works have changed their rates and 56.5% have not. Water bills are paid monthly in 98 cities and quarterly in 15. There is a hydrant charge, averaging $31.40, in 43 cities, or 38% of the number reporting. Of the 113 cities, 93, or 82.3%, have over and 17, or 15%, have under 50% of their taps metered and only three works, or 2.7%, depend on flat rates. Ownership of meters is 48% by either the city or the company, 39% by consumers and 13% mixed. Meter installations are 52% by the city or company and 48% by consumers, and maintenance of meters is 65% by the works and 35% by the consumers.

Large Train-Shed Raised Without Traffic Interruption

Subsidence of Pile Foundations of Lackawanna Railroad Structure at Hoboken, New Jersey—Behavior of Cast-Iron Columns—Progressive Jacking

THE Delaware, Lackwanna & Western R.R. has just completed the raising of the smoke-duct train-shed at Hoboken, N. J., which covers about five acres and weighs some 9000 tons. The work was done without interruption to traffic in the terminal, which amounts to 50,000 passengers per day. During 13 years of service there had been irregular settlement, in amounts of 5 to 16 in., in the pile foundations driven into the mud of what once was the bed of the Hudson River. It had, therefore, been necessary to bring the trucks up to a temporary grade, and it was recently decided to raise the shed to a permanent level in order to accommodate the largest locomotives on all tracks. During the work, the raising of one section at a time by simultaneous jacking of the columns was abandoned after it had been found possible to jack continuously from one end of the structure to the other, without disconnecting it at each expansion joint. A feature of the settlement and raising was that some important changes in the design of the original structure were suggested. The shed was built in 1906 and was the first of the Bush type, or smoke-duct, train-sheds in this country. The general plan and elevations are shown in Fig. 1. Details of the typical section are shown in Fig. 2. The train-shed itself is supported on 207 cast-iron columns. It is divided laterally by expansion joints at every fifth column and at the point adjoining the roof of the concourse. Descriptions of the structure appeared in *Engineering Record* of June 24, 1905, p. 706, and in *Engineering News* of Sept. 20, 1906, p. 297.

The foundations of the shed consist of four-pile clusters supporting each of the column piers. The platforms and tracks are carried on piles at 9-ft. centers. All of the piling is over 80 ft. in length. As measured at the columns, settlement of 5 to 16 in. had occurred. While the reasons for settlement are not apparent, it is thought to have been brought about by the same general conditions as those which almost invariably have produced settlement in heavy structures supported on piles driven in the silt of the Hudson River. Irregular settlement of the tracks had also occurred, so that it was necessary to bring them up to a temporary uniform grade. Since this made it impossible to use all of the tracks for the largest locomotives in service, it was recently decided to raise the shed, and, now that this has been completed, the tracks will be brought up to permanent grade, and the level of the train platform will be raised by filling in with concrete. Typical profiles of old and new levels are shown in Fig. 3.

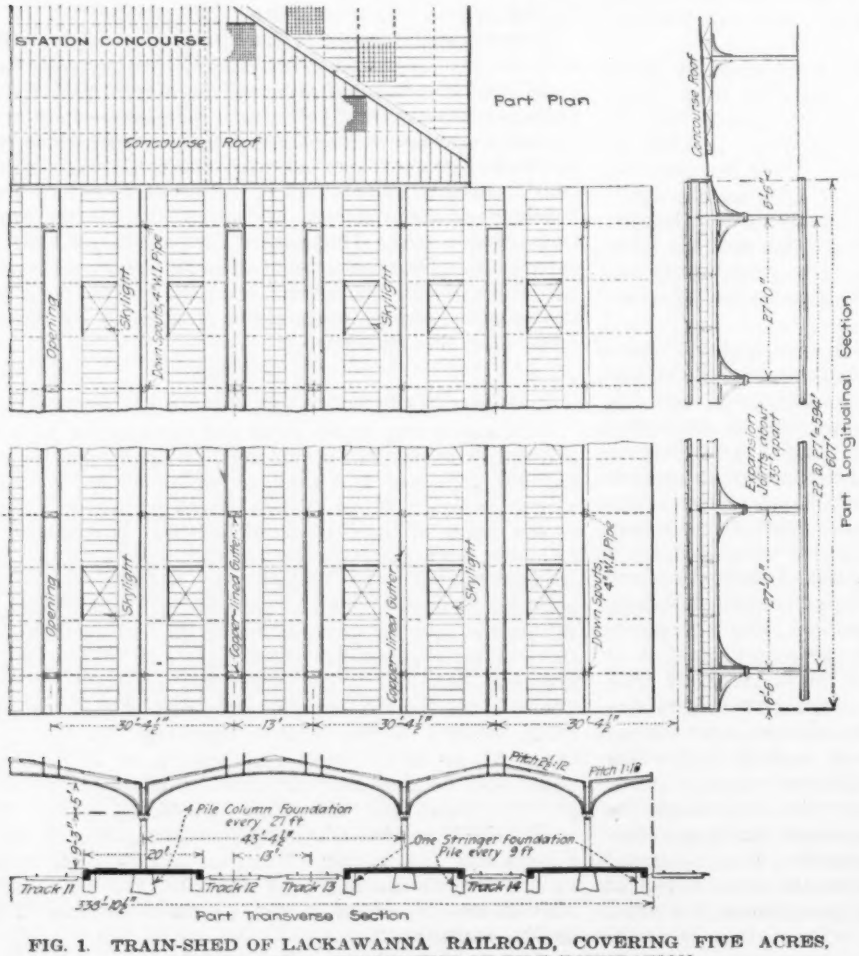


FIG. 1. TRAIN-SHED OF LACKAWANNA RAILROAD, COVERING FIVE ACRES, RAISED AFTER SETTLEMENT OF PILE FOUNDATION

In raising the shed, one of the most important considerations was to insure the continuous and uninterrupted service of all portions of the terminal, with as little inconvenience to passengers as possible. Only a small space, which was roped off down the centers of the platforms, was reserved for jacking operations. Difficulty was experienced in making temporary provision for drainage during the heavy rains which occurred during the work, as the downpipes were located inside the columns and had to be disconnected at the base before raising started.

It was at first thought that further settlement might occur as soon as jacking operations began, and provision was made accordingly by the use of jacks capable of making lifts considerably greater than those called for. During all periods of the work it was necessary to exercise the greatest care to avoid too rapid or unequal jacking, in order to prevent damaging

the structure. It was considered necessary to disconnect the shed laterally at each of the four expansion joints and at the roof of the concourse, dividing it up into five sections so that each section could be raised separately by jacking all of the columns simultaneously.

Preparations for the work involved cutting away the concrete around the bases of the columns and removing

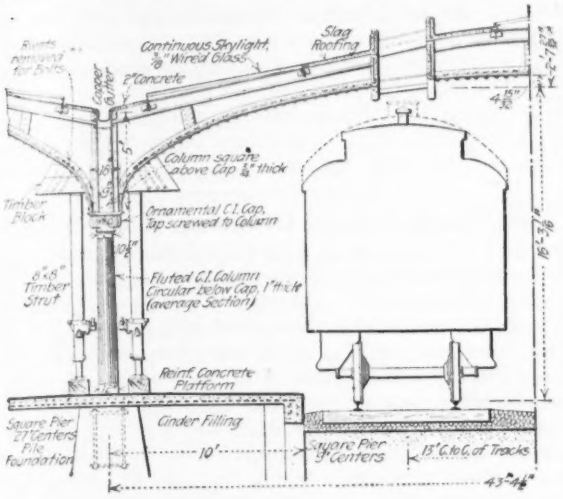


FIG. 2. DETAILED CROSS-SECTION—JACKS IN POSITION

rivets from the flanges forming the section of the roof support next to the columns, in order to provide for bolting on wooden blocks to take the jacking shores, as shown in Fig. 2. The jacks were set on timber blocks placed on the concrete train platform and worked against 8 x 8 timber struts placed under the blocks at the tops of the columns.

When jacking started, the east section of the shed had been separated from the rest of the structure by disconnecting of the expansion joints at the fifth column and at the concourse roof. Some of the columns were considerably lower than those adjacent to them on both sides, and it was believed at first that these columns (which required the greatest lift) could be raised approximately to the elevation of those adjacent to them, with a comparatively small jacking force. It was found, however, that certain portions of the structure had taken a permanent set and that the columns adjacent to the lower joints had also to be raised slightly during the first period of jacking. All of the columns in the section were then jacked simultaneously to the required elevations.

It was indicated during the raising of this section that the remainder of the shed could be jacked continuously without disconnecting at the other three expansion joints, and at a saving of considerable expense. The method employed is shown diagrammatically in Fig. 4. The bents of columns in the next section (A, B, C, D and E) received an average lift of, say, 2 in.; columns A, B, C and D would then receive an additional lift; then columns A, B and C, and so on, until the new elevations had been reached. As soon as the required lifts had been made, the bases of the columns were concreted in and the jacks were removed. Then jacks would be applied to the adjacent columns, F, G, H, etc., and the process carried on continuously to the far end of the shed, until jacking and concreting were completed. There has been no apparent failure, due to jacking, in any of the longitudinal members.

Experience developed during the settlement and raising of the structure has demonstrated, in the opinion of some, the desirability of several changes in the original design. It was found that about 30 of the 207 cast-iron columns had failed. As far as could be determined, not more than five or six had failed in jacking. It was noted that several had cracked longitudinally, and it is thought that this type of failure had undoubtedly been produced by bursting from freezing. In some of the columns the failure took place in the machined portion, extending for 4 or 5 ft. into a tight fit in the bases of the fabricated roof arches. While it is recognized that erection stresses and wind stresses may have been a contributing factor in the failures, the conclusion has been drawn that stresses set up during settlement were

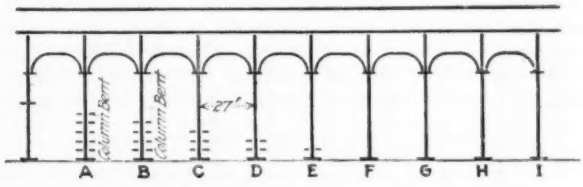


FIG. 4. SHED RAISED BY PROGRESSIVE JACKING

the chief factor in most of the breakages, and that steel columns should be used rather than those of cast iron, for similar structures, when settlement is at all likely.

Following the raising of the shed, the skylight area is now being reduced by half, through the substitution of reinforced-concrete slabs. It was found very expensive to maintain so large an area of wired-glass sky light, on account of excessive breakage, and skylights of the

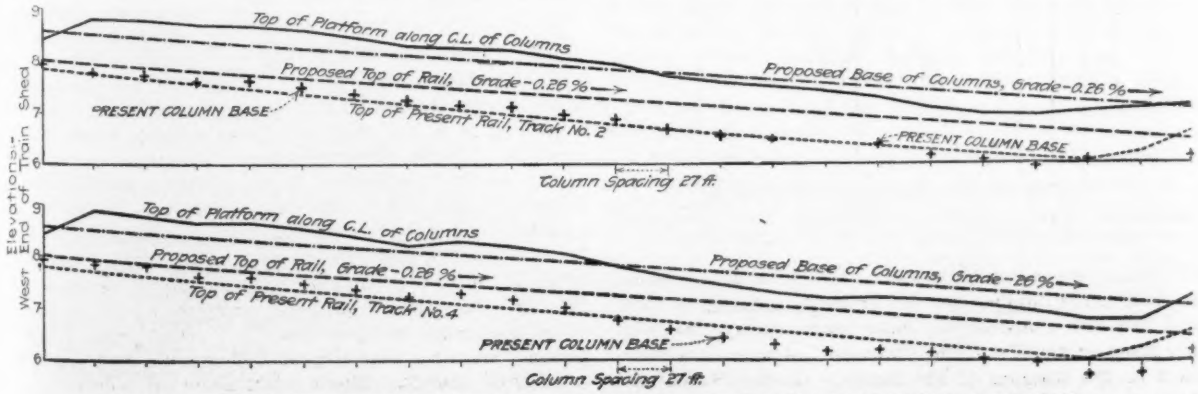

Top of Platform along C.L. of Columns
Proposed Top of Rail, Grade -0.26 %
Proposed Base of Columns, Grade -0.26 %
PRESENT COLUMN BASE
Top of Present Rail, Track No. 2
PRESENT COLUMN BASE
Column Spacing 27 ft.
Elevations—West End of Train Shed
Top of Platform along C.L. of Columns
Proposed Top of Rail, Grade -0.26 %
Proposed Base of Columns, Grade -26 %
Top of Present Rail, Track No. 4
PRESENT COLUMN BASE
Column Spacing 27 ft.

FIG. 3. TYPICAL PROFILES OF OLD AND NEW LEVELS. LIFTS OF 5 TO 16 INCHES REQUIRED

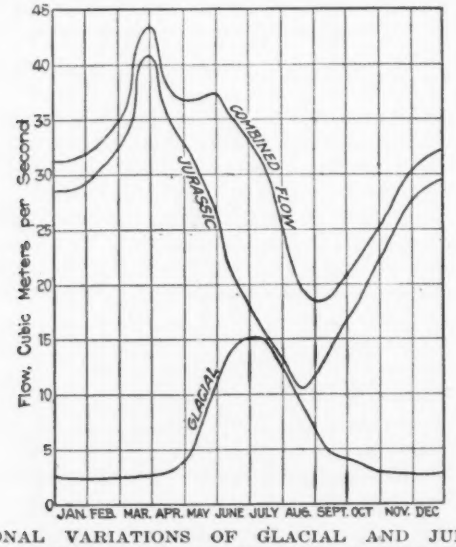
vault-light type will be substituted for the remaining skylight area. Another suggested improvement, over the original design, is in the drainage system. On account of the inaccessibility of the downpipes inside the columns, connecting with central drains under the tracks, and difficulties experienced from clogging with cinders, it is thought that drains on the outside of the columns would be preferable and that, in a new design, manholes in the train platforms should be provided to give access to the central drains in the event of serious clogging.

The work of raising the shed commenced early in June with the cutting away of the concrete around the oclumn bases. About ten men were engaged in this work continuously for approximately a month. At the same time, work was started removing a sufficient number of rivets from the flanges of the arches so that blocks could be bolted on. This was still in progress after jacking had started in the middle of July. Jacking was completed Aug. 12. About 40 men were engaged in the work. It was done by the forces of the railroad company, in charge of L. L. Tallyn, acting chief engineer, A. E. Deal, bridge engineer, and M. H. Doughty, division engineer.

Utilizing Differences in Seasonal Stream Flow in France

By Edward H. Sargent
Senior Assistant Engineer, New York State Conservation Commission, Albany, N. Y.

In making an investigation of the water-power possibilities in France susceptible of use by the American Expeditionary Forces, the writer came upon an interesting utilization of the difference in phase of rivers having their origin in different climates. The rivers in France which rise in the Alps are called "glacial" streams, while those that flow through the central part



SEASONAL VARIATIONS OF GLACIAL AND JURASSIC STREAM FLOW IN FRANCE DUE TO CLIMATIC EFFECT

of France are called "Jurassic." The "glacial" streams, as their name implies, are fed from the melting of snow and ice, and consequently have their highest flows in the summer months. The "Jurassic" streams are more akin to the streams of the Eastern United States and have their high flows in the spring and the low flows in the summer. One of the larger water-power companies, the "Compagnie d'Energie Electrique du Litteral Méditerranéen," took advantage of this difference of phase of two rivers and developed and interconnected water-power plants on both rivers.

The flow of the individual rivers and of the two combined are shown on the accompanying diagram. As the heads of the two plants are about the same, it is interesting to note the effect of adding the corresponding flows of the two streams. The diagram shows that the period of the lowest water of one river almost coincides with the period of the highest water of the other. The lessening of the need of auxiliary power by this happy combination is very apparent.

The English Land Drainage Act of 1918

Largely extended powers to provided land-drainage works and to organize drainage boards are now available in England, according to an article by H. T. Wakelam, county engineer of Middlesex, England, in *The Surveyor and Municipal and County Engineer* of Aug. 8, 1919. Mr. Wakelam states that action under the drainage acts of 1847 and 1861 had proved to be "so difficult and expensive that, owing to the extraordinary conditions and requirements in connection with the production of food during the war it became necessary for the Government" to pass supplementary legislation.

The primary object of the new act is to make possible flood-prevention work to obviate floods that "have been caused by inadequate drainage, and in many cases by complete lack of drainage facilities."

Under the new act, petitions may be submitted to the Board of Agriculture and Fisheries by county councils, county boroughs, existing drainage boards and land owners, for the formation of drainage areas to be administered by drainage boards. County councils may also petition the board named to enable them to take over the powers, duties and properties of existing drainage authorities. In such cases the Board of Agriculture and Fisheries consults with the Local Government Board before ordering a transfer.

Drainage boards organized under the new act are authorized, according to Mr. Wakelam, "to undertake flood prevention and other works of an engineering character at the cost of the owners of any lands within such areas as may be prescribed and which may benefit from the carrying on of any such work."

The act is outlined in considerable detail by Mr. Wakelam in the article mentioned.

Gas Producers at Small Water-Works Station

Gas producers are used as a source of power at the water-works pumping station of Manchester, Mass., according to a statement by Henry A. Symonds, civil engineer, Boston, in a paper on "Engines for Small Water-Works," published in the *Journal of the New England Water Works Association* for June, 1919. One producer supplies two 65-hp. engines direct-connected to two Gould's vertical triplex pumps, each having a capacity of 700 g.p.m., operating against a head of 280 ft. The second producer supplies 50-hp. engines direct-connected to two Gould's double-acting triplex pumps, having a capacity of 530 g.p.m., each against a head of 280 ft. These units show an efficiency of 150,000,000 ft.-lb. per 100 lb. of fuel in daily operation.

Corrugated Spacer Used for Wood-Block Pavements

Simple Cardboard Device Spaces Blocks, Provides for Expansion and Stops Bleeding—Method of Laying Changed

By John S. Crandell

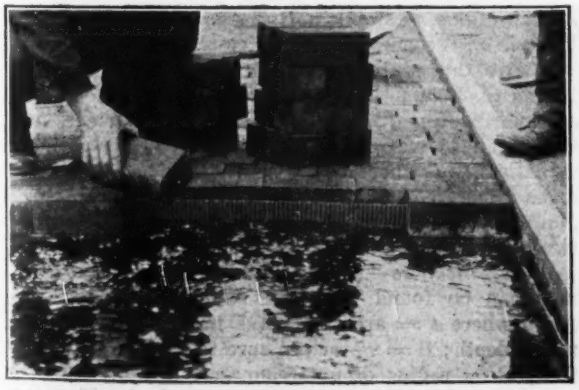
Consulting Engineer, The Barrett Company, New York City

TO PREVENT bulging of wood-block pavements due to swelling a corrugated cardboard spacer was tried recently on W. 34th St., New York City, between 5th and 6th Aves., with satisfactory results. While giving a uniform spacing for the admittance of filler, thus sealing the pavement against the percolation of water, the spacer also allows for expansion. Furthermore, bleeding of the filler is stopped, as the spacing material acts as a dam. The only change in construction methods is in setting the blocks.

Thirty-fourth street is subjected to intense traffic, both pleasure and commercial. The old wood-block pavement had been cut and had settled in a number of places, and it became necessary to re-lay much of the surface. As far as possible, the old block was salvaged and used for re-laying. Probably 75% of the repair was made with the old block. The new block is of width different from the old, but of the same depth. On removing the block, it was found that the sand cushion had shifted considerably, causing much of the unevenness of the pavement. Therefore a sand-cement bed was substituted for the plain sand cushion, and the blocks were bedded on it.

Numerous devices have been tried in the past to space wood blocks sufficiently to permit the entrance of paving pitch into the joints. For a number of years the wood-block pavements in London, England were laid with strips of wooden lath between the rows of blocks. While this undoubtedly spaces the blocks so that the filler readily finds its way to the bottom of the joints, lath is not sufficiently compressible to permit the blocks to expand at the bottom, and buckling takes place whenever the blocks absorb water. Lug block is also used and has proved satisfactory in overcoming buckling, but nothing has been used as a spacer between plain rectangular blocks that had been successful in permitting them to expand.

The corrugated card-board used on 34th St. to accomplish this result is single-faced and is laid in the transverse joints of the pavement, as shown in the view.



CORRUGATED CARDBOARD SPACER PERMITS EXPANSION

Itis $\frac{3}{16}$ in. thick by 1¼ in. deep. The paver must change his method of laying the blocks so as to lay one row continuously across the street, as the strip interferes with the usual method of laying four or five rows at once. However, after a short time the pavers are able to lay almost as rapidly as under the old method. The foreman, John F. Schlier, stated that he was able to lay the same yardage per day using the strip as without it.

After the pavement is laid, paving pitch is poured over the blocks and squeegeed into the joints in quantities

PITCH SQUEEGEED INTO JOINTS

sufficient to fill them to one-half their depth. Sand is swept into the unfilled space, and the pavement is immediately ready for traffic. The end joints of the blocks are filled by the pitch running around the corners from the transverse joints. Thus, all of the interstices in the surfacing are completely sealed against the entrance of water, and every joint is an expansion joint, permitting the blocks to expand to their maximum size without causing any buckling of the pavement.

One noticeable feature was the absence of filler on the top of the blocks. When properly squeegeed the pitch finds its way readily into the joints, and the tops of the blocks are practically free from it. This undoubtedly will prevent the formation of objectionable mat coats of filler. The spacer also acts as a dam to prevent the filler, which extends only slightly above it, from running to the gutters, no matter how great the crown or grade.

While the spacer is $\frac{3}{16}$ in. in thickness, it is impossible to keep the joints down to that width. The open spacing may be seen in an illustration. Measurement of a large number showed that the average width is ¼ inch. At the present writing, the patches have been down several weeks, and there is no sign of bleeding or of the blocks dragging under traffic.

Corrugated paper is inexpensive and can be obtained in quantity from manufacturers, and cut to the required size. Ordinarily, the paper comes in rolls 250 ft. long by 36 in. wide. This can be cut by the manufacturers into strips 250 ft. long by 1¼in. wide, or any other width that is desired. However, experiment has shown that 1¼ in. is the most satisfactory width to use. A patent has been applied for by the writer.

The work described was laid under the supervision of William E. Dey, engineer of maintenance, Bureau of Highways, Borough of Manhattan.

Fundamentals in the Design of a Multiple-Arch Dam

Applicability and Restrictions of This Type of Structure and Principles Controlling Its Design—Illustrated by the New Lake Eleanor Dam for San Francisco Water-Supply

By R. P. McIntosh
Hydraulic Engineer, City Engineer's Office, San Francisco, Calif.

MULTIPLE-ARCH concrete dams are comparatively recent in engineering practice, but they are receiving increasing favor, particularly on the Pacific Coast. Their use, however, has not been wide enough as yet to establish any standards of applicability or design. In the preparation of the plans for the Lake Eleanor dam, a unit of the Hetch Hetchy water-supply for San Francisco, the writer, under the direction of M. M. O'Shaughnessy, city engineer, and with the collaboration of R. J. Wood, devoted some attention to the standardization of the design of dams of this type. Lars Jorgensen, consulting hydraulic engineer, also collaborated on these plans. From this work there developed some conclusions that seem worth recording for future reference.

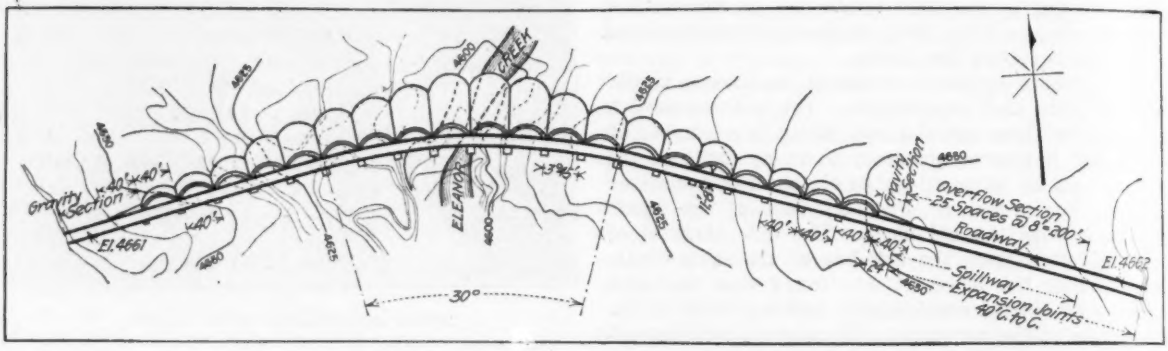


FIG. 1. PLAN OF LAKE ELEANOR DAM FOR HETCH HETCHY WATER-SUPPLY, SAN FRANCISCO

General Considerations in Design—Application of the multiple-arch dam should be limited to locations where there is a solid rock foundation, or one which can be thoroughly solidified by artificial means, thus entirely preventing the settlement of any of the buttresses.

For dams higher than 125 ft. the buttresses become large and require a great deal of bracing in order to prevent failure by buckling. The cost of the structure above this 125-ft. height increases quite rapidly, and, except in certain cases where special topographic features or other conditions govern, it will probably be found that a single arch or other type of dam will be more economical. For the usual conditions met, and for dams less than 100 ft. in height, the multiple-arch type may effect a saving in cost of from 10% to 25% over either the single-arch or the gravity concrete dam.

Under all conditions of water load, the arches are practically subjected to compressive stresses only, and no steel would be required if it were not for the fact that tension may be found to exist over part of the arch section when stresses due to temperature changes and rib shortening are considered.

Arch Span—In deciding on the arch span, several points must be kept in mind: (1) The total concrete in the buttresses is theoretically independent of the arch span; (2) the span length should be a constant throughout the structure; (3) short-span arches will require less material than long-span ones; however, the cost of the structure may not be less with short spans, since a great deal of additional form work is required, and also the satisfactory placing of the concrete and steel in the thin sections becomes slow, tedious and expensive; (4) a certain minimum thickness of first-class concrete is required in the arches for water-tightness, and this would have to be provided, even if short spans were used; (5) very thin buttresses (based on short arch spans) would require excessive bracing to prevent failure by buckling before the unit stresses even approached the crushing strength of the material.

Based on a study of the above facts, the most economical limits for the arch span will be found to vary from about 25 to 50 ft., depending upon the height of the dam, the 50-ft. span being used for dams about 100 ft. in height.

Length of Upstream Radius—It is a well known fact that the most economical arch is one which subtends a central angle of 133½°, and that variations up to 15% from this value do not increase the volume of the arch more than 1% or 2%, and this is permissible in order to meet other conditions. (See Am. Soc. C. E. *Transactions*, Vol. LXXVIII, p. 690.) With the central angle and span known, the upstream radius is readily calculated. This radius should be kept a constant from the top to the bottom of the arch.

Slope of Water Face—For a given arch span, upstream radius, allowable unit stress, and height of dam, there is an "economical slope" for the water face which will give the minimum volume to the dam. In computing the volume for several cases (in which the arch and pier footings, braces, etc., were not considered) it was found that for heights of 50 to 75 ft. the economical face slope was about 50° with the horizontal, and for dams from 25 to 50 ft. high this angle is nearer 60°. However, a variation of a few degrees will have practically no influence on the final cost of the structure.

Arch Thickness—A preliminary or trial arch thickness can be found from the simple formula: $t = PR/q$ where t = arch thickness in feet for any horizontal depth; P = water pressure in pounds per square foot; R = radius of upstream face in feet and q = average stress in pounds per square foot. However,

since the radius of the arch is usually comparatively small, the above formula will give a thickness which should be considered the minimum, and it will usually be found desirable to increase this thickness very materially in order to secure water-tightness as well as an arch which has sufficient stiffness for the span length. Of course, the same result could be obtained by using a low value for q, the intensity of stress. The designer will have to assume a practical thickness for the arch ring near the top, since the above formula (being based on water pressure) gives a zero value for t. When the final analysis of the stress in the arch is made, it will be necessary (as will appear later) to include one component of the weight of the arch itself along with the water pressure.

Shape of Arch—It has been customary in most of the multiple-arch dams built to make the arch barrel a cylinder; that is, the radius is given in a normal plane making a normal section circular, the thickness at the crown and springing line being the same. This is obviously incorrect, since a point at the crown of the arch will always be higher than a corresponding point at the springing line, and this difference in elevation causes a normal arch ring to be subjected to a variable loading—which means, if the normal section is a circle, that the line of pressure will not even approximately coincide with the arch axis. Unnecessary bending stresses are thus introduced. This is more noticeable in the upper part of the structure.

The more logical method is to make the radius horizontal, giving a circular section of constant thickness in a horizontal plane, where the water pressure is a constant. A normal section will then be elliptical and the thickness will increase from the crown to the springing line, giving greater stability to the arch ring.

By this method the center line of the arch ring and the line of pressure can be made to coincide quite closely for all depths.

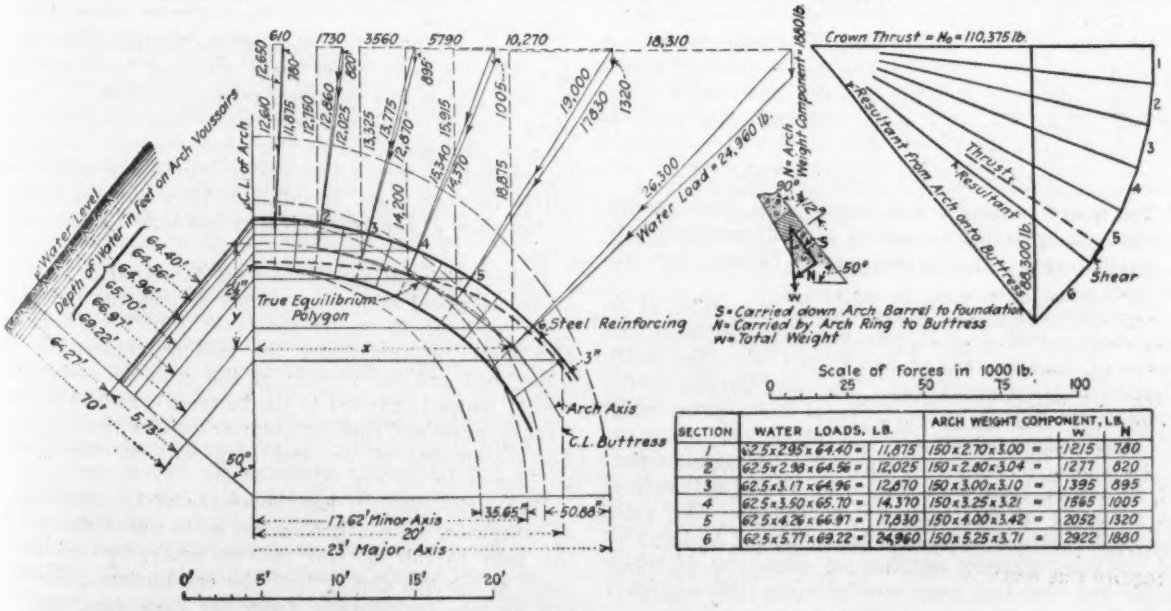
It is better to make the top few feet of the arch barrel vertical (it will be circular), since if the inclined face is carried to the top there will be triangular portions of the barrel at the top, next to the buttresses, which will be subjected to cantilever bending, there being nothing to offer a reaction along the top end or face.

The extreme upper and lower ends of the inclined arch barrel are not capable of being rigidly analyzed.

Division of Arch Weight—The weight of the arch barrel itself is carried in part to the buttress and in part down the arch to the foundation. Since these two components are sometimes confused, the small diagram in Fig. 2 is used to illustrate the conditions. The weight of each element (w always acting vertically) can be considered as broken up into two components, N and S. The S component is carried down the arch to the foundation, and the N component is carried by the arch into the buttress. Furthermore, regarding the normal component N there exists a difference of opinion among designers as to the direction of its action. Some engineers consider it to act normal to the arch face at all points and therefore to be directly additive to the water pressure. It is believed that the more correct method is to consider N as always acting normal to the face of the buttress. It naturally follows that the amount, point of application and line of action of the resultant force on the buttress will vary considerably, depending on which of the above two methods is used.

As a contention for the latter method, the following argument against the former should be noted: In the limiting case in which the arch barrel subtends an angle of 180°, if the last element of the arch next to the face of the buttress is considered, it will be seen that the line of action of the S component down the arch barrel is here parallel to the face of the buttress, and if the N component (always at right angles to S) acts normal to the arch face, it would also be acting at right angles to the direction of the weight w. In other words, we would be resolving a force into two components, one of which forms an angle of 90° with the original force, and this, of course, is impossible.

Buttresses—The buttresses are first given some trial dimensions based on the designer's judgment, care being taken that the upstream face of the buttress is at all



SECTION	WATER LOADS, LB.		ARCH WEIGHT COMPONENT, LB.		
				W	N
1	62.5×2.95×64.40 =	11,875	150×2.70×3.00 =	1215	780
2	62.5×2.98×64.56 =	12,025	150×2.80×3.04 =	1277	820
3	62.5×3.17×64.96 =	12,870	150×3.00×3.10 =	1395	895
4	62.5×3.50×65.70 =	14,370	150×3.25×3.21 =	1565	1005
5	62.5×4.26×66.97 =	17,830	150×4.00×3.42 =	2052	1320
6	62.5×5.77×69.22 =	24,960	150×5.25×3.71 =	2922	1880

FIG. 2. STRESS ANALYSIS OF AN ELLIPTICAL ARCH RING OF DAM AT 70-FOOT DEPTH

points wide enough to receive the two adjacent arches. This trial section is then analyzed to see that the amount and distribution of the stresses are within the allowable practical limits. The graphical method is the most convenient for this purpose. The dimensions and batter for the buttresses in the low part of the dam (near the ends) need not be kept the same as for the high sections.

There should be some form of bracing between the buttress such as reinforced struts or beams, etc., which are capable of withstanding either tension or compression. It is also well to place small stiffening wings or counterforts on the buttresses near their downstream face (and at other points if desired).

The amount and distribution of steel in the buttresses is mainly dependent on the designer's judgment. At the upstream face, or junction with the arches, additional stiffness should be provided by embedding three or four rods (hooped as in columns) on a slope parallel to that of the face arches. This construction also offers an extra means of tying the arch reinforcement into the buttress. Some of the struts between buttresses should be placed opposite these inclined girders. It is considered by some designers that in case one arch should fail this hooped column or inclined girder will take up and distribute to the buttress the unbalanced thrust from the remaining arches and thus prevent the entire dam from collapsing. While there may be a tendency for the girder to act in this way, no such dependence should be placed on it in designing.

The reinforcement in the buttress, aside from taking care of the temperature and part of the shearing stresses, acts in conjunction with the system of counterforts and braces between piers, helping to take care of wind stresses and to stiffen the pier against buckling.

Forms—The form work, scaffolding, etc., play a very important part in multiple-arch dams, and for this reason should receive special consideration. If this is not done, the cost of the dam may be considerably increased, due not only to the quantity of lumber required but to the large number of carpenters and laborers necessary to keep the form work ahead of the concrete pouring and thus prevent delay in the completion of the structure.

The fact that the normal section of the arch barrel is made elliptical, rather than circular, does not introduce any additional difficulty into the construction work, if the proper design is made, and the office work is increased only slightly.

Design of the Eleanor Dam

The above principles will probably be more readily understood by giving an outline of their application to a specific case. For this purpose the Eleanor dam will be used.

This dam lies in the Sierra Nevada Mountains at an altitude of 4650 ft. It was recently completed and is one of the first units of San Francisco's great Hetch Hetchy water-supply project. The main purpose of the present low dam is to supply water for a power plant for construction purposes.

As shown by accompanying plans, the dam consists of 20 arches, each with a span of 40 ft. and inclined at an angle of 50° with the horizontal. The eight center arches are themselves on a curve. At the ends of the dam, gravity sections are used, one of which is of the overflow type and provides the necessary spillway.

The foundation is solid rock. The height of the central arches is practically 70 ft. This dam will form part of the upstream toe of a future rock-fill dam similar to the Morena Dam, San Diego, with an ultimate height of 150 to 175 ft., and this accounts for the dam being curved in plan.

From various preliminary studies it was decided that the most economical dam meeting present and future requirements would result with a pier spacing of 40 ft. and a face inclined at an angle of 50° to the horizontal.

The radius of the upstream face of the arch barrel was made 23 ft. in a horizontal section. This, with the 40-ft. buttress spacing, gives a subtended central angle of 120° 50′, which differs less than 10% from the theoretical economic value. (See Fig. 3.) The top 7 ft. of the arches is made vertical, the horizontal radius of 23 ft. being maintained.

Arch Thickness in Horizontal Planes—The upper 7 ft. (vertical) was made 15 in. thick, which was considered to be about the practical minimum to meet all conditions. At the maximum depth of 70 ft. the thickness is pracically 4 ft. horizontally and 3 ft. 1 in. in a normal plane. Substituting the 4-ft. thickness in the

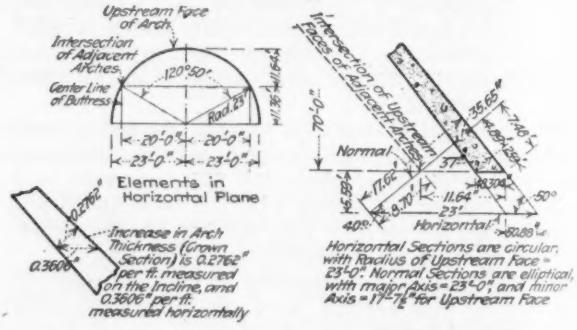


FIG. 3. DETAIL POINTS IN DESIGN OF MULTIPLE-ARCH DAM

formula $t = PR/q$, the average stress due to water pressure is seen to be only 175 lb. per square inch. This will be increased somewhat by the additional weight component, etc.

Buttresses—The dimensions of the buttresses for this dam (Fig. 4, next page) were governed somewhat by the fact that it was necessary to carry a 12-ft. roadway along the top. This roadway, which was designed continuous, also served to tie the whole structure securely together at the top, and lessens the number of struts required between piers. It will be noticed that the batter on the sides of the lower piers is less than for the high ones.

Typical Calculations at 70-Foot Depth—The section of the elliptical arch ring, which strikes the buttress at a depth of 70 ft., is shown in Fig. 2. There is also shown in this figure the loading (consisting of water load and the portion of the concrete arch ring weight which is carried to the buttress), as well as the force diagram and true funicular or equilibrium polygon. The dimensions of the arch ring will be clear from an inspection of Fig. 3.

Unless the designer has, by means of his experience or otherwise, made a good guess as to the thickness of the arch barrel, he will find on analyzing the arch rings at various depths that the equilibrium polygons will deviate considerably from the arch axis, and it

will be necessary to assume a new thickness and run through the analysis again.

In testing the preliminary arches a great deal of labor can be saved by using an approximate method such as is given in "Reinforced-Concrete Construction," by Hool, Vol. III, pp. 46 and 58. When a tentatively satisfactory section has been found by the above method, it should be completely analyzed by the elastic theory in order to obtain the true equilibrium polygon and determine the true stresses. After one or two trials an arch shape and thickness can be found in which the equilibrium polygon coincides very closely with the arch axis throughout its entire length, thus giving lower maximum stresses.

The method of analyzing the arch ring by the elastic theory will not be gone into in detail in this article, since the method is entirely standard and can be bound in any good treatise on reinforced concrete, such as Hool or Turneaure and Maurer. The method is essentially as follows: The arch ring is divided into an even number of sections in such manner that S/I is constant for all.

The loads on the sections are next computed and their line and point of application shown on the arch ring. The next step is to compute the thrust, shear and bending moment at the crown (this thrust will act horizontally and the shear will be zero for the present case; that is, symmetrical loading). Construct the force diagram and equilibrium polygon as shown in Fig. 2. Determine thrusts, shears, bending moments and eccentric distances at the centers of the divisions of the arch ring. These thrusts and shears are readily found with sufficient accuracy from the force diagram (as shown) but the moments should be computed algebraically. Compute the thrusts, shears, and moments, due to variation of temperature and rib shortening. Combine the thrusts, shears and moments due to the loads with those resulting from temperature and rib shortening and compute the maximum stresses, compression in the concrete and tension in the steel. It will be found that the shears are usually small and need not be considered. Thrusts and moments due to rib shortening are also, as a rule, comparatively small.

The stresses in the concrete of the Eleanor dam, computed as outlined above, were kept slightly below 300 lb. per square inch and the stresses in the steel below 4000 lb. per square inch (due to water load only).

Temperature considerations are more important in the upper part of the structure, since the lower portion is usually covered with water. Also, the lower portion of the arch barrel is thicker and more heavily reinforced.

Rib shortening stresses, as stated above, are usually small. The crown thrust when found may be expressed as a percentage of that due to temperature,

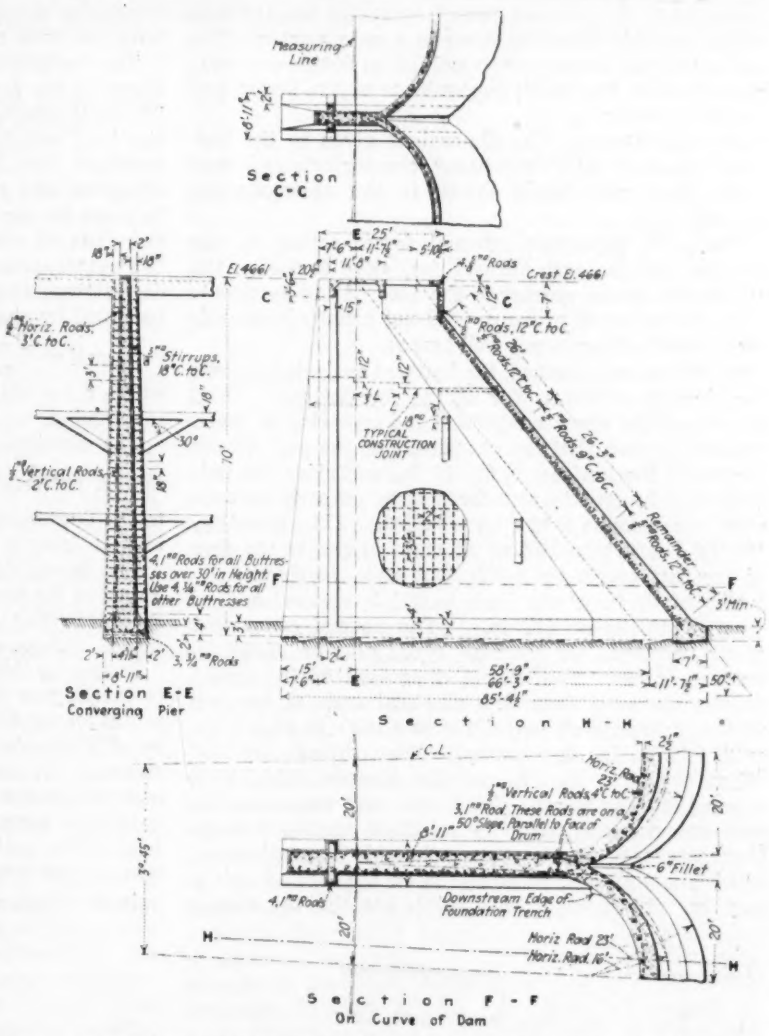

Measuring Line
Section C-C
Crest El. 4661
El. 4661
Horiz. Rods, 3'C. to C.
Stirrups, 18"C. to C.
Vertical Rods, 2'C. to C.
TYPICAL CONSTRUCTION JOINT
Remainder
3'Min.
4,1" Rods for all Buttresses over 30' in Height. Use 4, ¾" Rods for all other Buttresses
3, ¾" Rods
Section E-E Converging Pier
Section H-H
Horiz. Rods
Vertical Rods, 4'C. to C.
3,1" Rod. These Rods are on a 50° Slope, Parallel to Face of Drum
6" Fillet
4,1" Rods
Downstream Edge of Foundation Trench
Horiz. Rod 23'
Horiz. Rod 16'
Section F-F On Curve of Dam

FIG. 4. DETAILS OF THE CONSTRUCTION OF THE LAKE ELEANOR DAM

then the resulting moments and stresses will be this percentage of those due to temperature change.

The analysis for temperature and rib-shortening stresses is a part of the standard elastic theory and need not be considered in detail here. For method of finding these stresses as well as obtaining the maximum stresses in the arch ring, see Turneaure and Maurer, pp. 342-343, and Hool, Vol. III, pp. 50-60.

In the Eleanor dam, considering the arch ring at the bottom of the vertical portion of the barrel (that is, 7 ft. below the top) there is, for a temperature change of 50°, a crown thrust of 1060 lb. and a crown moment of 4110 ft.-lb. The average stress due to water load on the arch is 8050 lb. per square foot and the total thrust 10,060 lb. (thickness of ring 1.25 ft.). Crown thrust due to rib shortening is 100 lb.; crown moment, 385 ft.-lb., with crown moment due to water load taken as zero. The combined crown thrust is 11,220 lb., the combined crown moment, 4495 ft.-lb., and the resulting stresses in pounds per square inch are 215 for concrete and 3200 for steel.

It might be well to note that the temperature stresses may never actually be as large as computed, since the change in temperature is gradual, and tests seem to in-

dicate that some sort of "flow" occurs in the concrete which tends to relieve the stress to a certain extent. The amount of this relief may be as high as 50% (or more), depending on the relative magnitude of the stress and the time factor.

Buttress Design—The dimensions given to the buttress, together with the bracing, counterforts and steel reinforcing, are clearly shown in the accompanying figures.

The most important external forces acting on the buttress are the arch thrusts (or, more correctly, the component acting normal to the face of the buttress). The effect of wind pressure need not usually be considered if the buttresses are well braced.

To indicate the method, the buttress analysis is shown for a depth of 70 ft. (or at the foundation). (Fig. 5.) From the stress analysis of the arch ring at 70-ft. depth it is seen that the component of the arch thrust normal to the buttress is 88,300 lb., and since the buttress is subjected to this force from an arch on each side the amount must be doubled. This quantity, 176,600 lb., is then laid off at right angles to the face of the buttress to any convenient scale, as shown.

The top 7 ft. of the arch barrel is vertical and of constant thickness (15 in.). The normal component of the thrust on the buttress is 8925 lb., or 17,850 lb. for two arches. The normal component of the thrust on the abutment from the elliptical arch at the top of the inclined arch barrel (in line *AB*) is 13,900 lb., or 27,800 lb. for two arches. These thrusts are laid off as shown in Fig. 5, and the diagram *TOLXERT* is completed as shown. This area will represent the pressure on the buttress, the resultant passing through the center of gravity. An allowable approximation which simplifies the work and is on the side of safety may be introduced at this point, namely, the simple triangular diagram *PLXP* can be substituted for the irregular area noted above.

The method of completing the analysis is clearly shown in the figure and requires no detailed discussion. The total external force (8,057,400 lb.) is combined with the total weight of buttress (1,928,600 lb.) and the resultant (9,412,000 lb.) is determined in amount, line of action, and point of application. This analysis can be made for several horizontal sections in the buttress, and lines of pressure drawn.

The intensities of vertical pressure (p_1 and p_2) at the downstream and upstream toes of buttress are then determined by the standard formula:

$$p_2 \text{ at } K = \frac{4b - 6ks}{db^2} \times V \text{ and } p_1 \text{ at } L = \frac{4b - 6Ls}{db^2} \times V,$$

where d = width of base, p_2 = 20,060 lb. per square foot and p_1 = 1460 lb. per square foot.

The absolute maximum intensity of stress in the section at 70-ft. depth is $p_3 = \frac{p_2}{\cos^2 \varphi}$. It acts parallel to the downstream face and on a plane at right angles to that face; p_3 = 20,300 lb. per square foot.

The intensities of pressure p_3 and p_2 are somewhat larger in the narrower horizontal section just above the spread footing of the buttress, but here they do not exceed 250 lb. per square inch.

In making the analysis of the buttress, it is customary to investigate the effect of shear at the various horizontal joints; however, it will usually be found that this is not a governing feature as regards the safety of the structure, if well built. This is more especially the case where the buttress is reinforced. If H is the horizontal component of the resultant thrust on the joint, V the vertical component, f the coefficient of friction, A the area, and S the shearing resistance per unit of area, then for safety against shear $H \leqq fV + SA$. Although S has an appreciable value, it is more or less indeterminate, and therefore usually neglected, and in that case if H is greater than fV, the additional shear may be considered to be taken up by part of the reinforcement.

In multiple-arch dams, the effect of uplift is generally neglected. This is justifiable, since the upstream face in nearly all cases is covered with a coat of mortar (½ to 1 in.) applied with a cement gun, which tends to make the structure more nearly water-tight. Moreover, any water which does enter the upstream face would probably percolate through the arch rather than along it and into the buttress. If it is desired to take account of the uplift, probably as good an assumption as any is to consider it as acting with an intensity of two-thirds the hydrostatic head at the upstream face, and decreasing uniformly to zero at the downstream face.

Forms do not come within the limits of this article, except that it should be stated that a three-centered curve can be used to approximate the true ellipse of the arch.

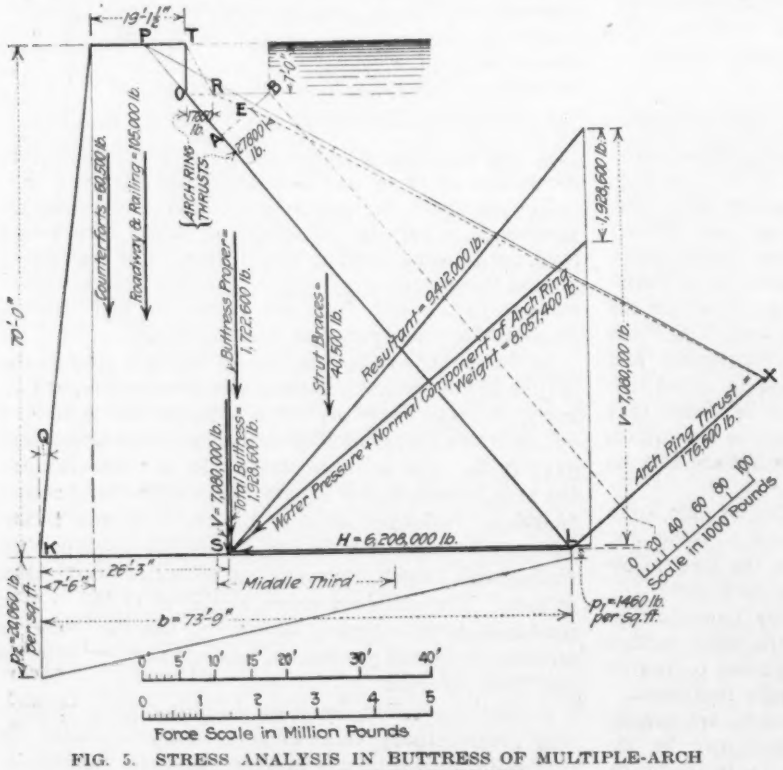


FIG. 5. STRESS ANALYSIS IN BUTTRESS OF MULTIPLE-ARCH DAM AT 70-FOOT DEPTH

Investigation of Odors From Lake at Madison, Wisconsin

Sewage Plant Gets Popular Blame, but Study Will Include Algæ, Trade Wastes and Surface and Street Drainage

COMPLAINTS of objectionable odors from Lake Monona, which receives the effluent from the sewage-disposal plant at Madison, Wis., led last summer to assertions of incomplete treatment of sewage at this plant, but investigation made in May, 1919, by John W. Alvord, consulting engineer, Chicago, indicates, in his opinion, that the plant is not to blame.

His report suggests that there are other and more important causes for the odors which were so offensive in the summer and autumn of 1918, and recommends that further study be made to determine the cause and provide a remedy. Most of the odor appears to be at points distant from the outlet of the sewage-disposal plant. Mr. Alvord points out that in 1917 he had an examination made of the working of this plant, and was so satisfied with its efficiency that he advocated similar sedimentation tanks for the plant at the United States Naval Training Station at Great Lakes, Ill., which has been in successful operation now for about 18 months.

Causes of Odors from Lake

Several causes for the objectionable odors are suggested by Mr. Alvord, including increased plant growths in the lake, trade wastes and street washings from storm sewers. As stated in his report, old residents agree that at times Lake Monona has given out considerable odor in the summer and autumn, this being described usually as of a decaying vegetable nature, with some reminder of the stable. With increasing population contributing pollution around the lake, the odors are said to be increasingly noticeable and objectionable. Some observers have asserted that the lake is peculiarly subject to algæ and other organic growths, such as occur even in reservoirs and lakes not subject to pollution, and the decay of which may produce very offensive odors.

Plant food for such vegetation may be furnished by the nitrates of inert sewage effluent as well as by agricultural drainage, with its pollution of varying character. It is pointed out that at Madison, apart from the sewage effluent, such food may be furnished by wastes from a large beet-sugar factory, the gas works and other industrial plants, as well as by surface drainage and the street washings from storm sewers.

It has been suggested by E. J. Tully, state sanitary engineer, that while the effluent from the municipal sewage plant is 99% stable, yet the harmless and unobjectionable nitrates which it contains may aid in promoting the growth of vegetation which later decays and putrefies and which causes the trouble. Mr. Alvord thinks that this theory is plausible, but he points out that if it is true no sewage plant in such a situation, however well operated, will be finally satisfactory if the proportion of nitrates which it contributes to plant life is large. Furthermore, there is no evidence as to the proportionate effect of the plant food from this effluent as compared with other and apparently greater sources of plant food which are poured into the lake.

Among the complaints discussed is the charge that raw sewage has been discharged from the plant into the lake. This the report states is "entirely unreasonable," as there is no way in which sewage can be bypassed, nor any occasion to bypass it, because the plant has considerable excess capacity. On the other hand, the plant has a good record, since the tanks have been in operation for nearly six years and the final percolating filter for over two years, with no dissatisfaction until 1918, when odors from the lagooning of sludge created prejudice against the plant. Another good record is that careful tests have shown the effluent to be almost continuously satisfactory, to the extent of being about 99% stable nearly all of the time.

Some aftergrowths occur occasionally in the final effluent, but there is enough dilution in the Yahara River at all times to oxidize such matter promptly and fully. Inert matter in the effluent may at times discolor it and cause aftergrowth which in dying causes a slight odor, but this is not large in amount or important in such plants, even when operating most successfully. The State Board of Health has recommended further treatment and clarification of the effluent. Mr. Alvord says that the aftergrowths and inert matter can be intercepted and removed if necessary, but he suggests that the expense might be considerable and that it is important to know first their relative importance as a factor in the problem, since it is possible that the money may be more advantageously expended when more is known about the cause of the odors in the lake. In view of these facts, Mr. Alvord states his opinion as follows: "It is difficult to understand how raw sewage or the spent sewage effluent can be considered as having any great or indirect influence in creating odors, much of these odors being observed in distant parts of the lake, and it is improbable to my mind that this can be the case."

Sludge disposal by lagooning appears to be a cause of odors in the vicinity of the sewage plant. Certain changes in the plant are recommended to improve this condition, but this has no relation to the problem of odors from lake water and will be noted in a separate article. The city has engaged Alvord & Burdick, consulting engineers, Chicago, to conduct an extensive physical, chemical and biological investigation of the lake odors. This investigation is to cover the rest of the season of 1919, and it is expected that a full report on this interesting problem will be made early next year.

Pipe Laying by Force Account in Salt Lake

Unit costs of labor on 6-in. water mains in Salt Lake City, Utah, to provide work for men returning from Government service, were $1.35 per cubic yard for excavating and backfilling trenches and $0.19 per linear foot for laying. The pipe cost $1.33 per linear foot, and the total cost of pipe valves, hydrants, special castings, trenching, laying and backfilling was $2.33. This included direct supervision only. Engineering cost 2.33% and inspection 0.55% additional. The foregoing figures are for a typical job done in January, 1919. This and similar work were authorized by a special act of the legislature and was limited to extensions costing not over $6000 each. Force-account work under authorization in August, 1919, totalled 55,200 ft. and was estimated to cost $134,500. W. A. Alexander is construction engineer in charge, under S. Q. Cannon, city engineer.

Viaduct Protected From Snowslides by Concrete Walls

Slides Damaged Tower Columns in Cascade Mountain Gorge — Bases of Shore Bents Incased in Concrete

By E. E. Adams
Assistant Engineer, Great Northern Railway Company, Seattle, Wash.

DESTRUCTIVE snowslides early in 1918, following warm weather and heavy rains which brought down the deep snows of the early winter months, did serious damage to three mountain gorge viaducts of the Great Northern Railway Co. in Washington. These structures are on the western slope of the Cascade Mountains, where the line descends on a 2.2% grade. To prevent similar damage, concrete protection walls have been built, incasing the bases and the lower parts of the exposed tower bents.

The most serious damage was done at a point just west of Alpine, Wash., where the line crosses a mountain ravine 350 ft. wide and 130 ft. deep on a plate-girder viaduct carried on steel towers, known as Bridge 408. Apparently a natural dam of débris had formed in the gorge far above the bridge, and when the rains loosened up the heavy snow that had fallen during the late months of 1917 this dam broke. The mass went down the channel Jan. 2, 1918, and struck bents 3 and 4 of the viaduct. The lower column sections, the cross-

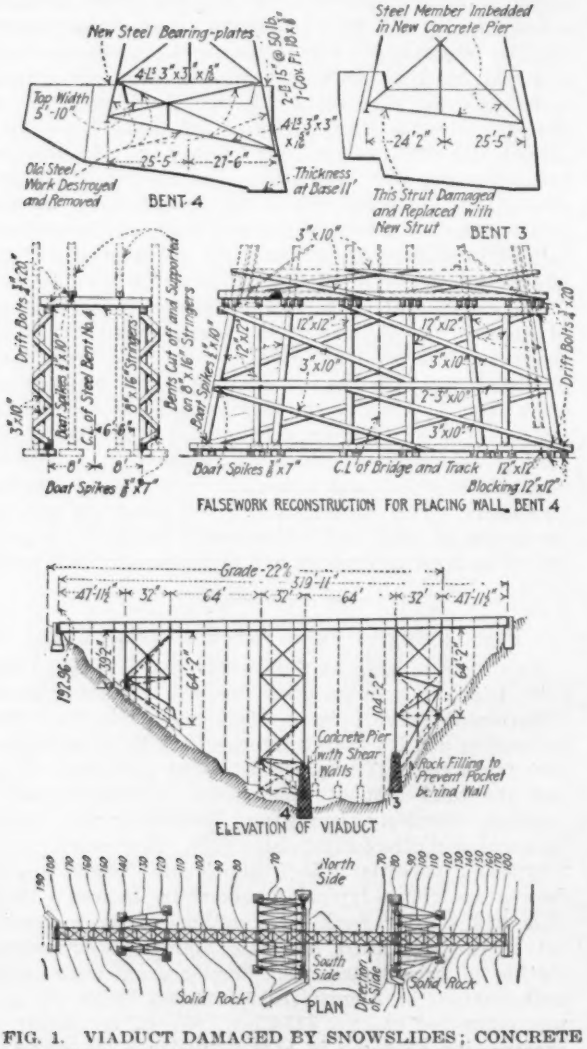


FIG. 1. VIADUCT DAMAGED BY SNOWSLIDES; CONCRETE PROTECTION WALLS, AND FALSEWORK TO SUPPORT GIRDERS DURING CONSTRUCTION OF WALLS

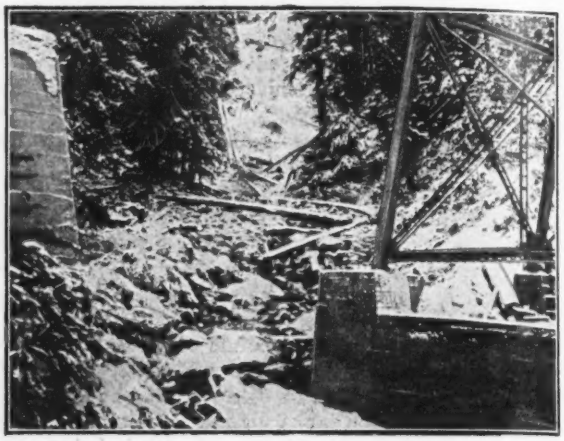


FIG. 2. SLIDE ZONE BETWEEN BENTS 3 AND 4 (LOOKING UP THE GORGE)

struts and the bracing of bent 3 were damaged and twisted, but the tower did not fall. In bent 4 the lower section of the upstream column was completely torn out, together with the upper parts of both concrete pedestals; the top of the bent was thrown out of true alignment and the girders settled, although the truss action of the bracing held the structure from falling.

Temporary repair of the damage was accomplished by setting up four heavy timber shoring bents, two on each side of the damaged bent 4. Thus supported, the structure carried traffic for nearly a year, until a decision had been reached as to means for giving permanent protection to the structure. The method adopted was to build concrete protection walls around the bases of bents 3 and 4, as shown in the drawing, Fig. 1, herewith.

Under the final plan, massive concrete walls incasing the lower sections of the bents were to be constructed, their foundations being carried to solid rock and the upstream ends of the walls being extended diagonally upstream into the bank as shear walls, to a junction with solid rock. The work was carried out accordingly, with only minor modifications to suit conditions as they developed. These walls will deflect future slides of snow, boulders or timbers into the channel between them, and away from the steelwork.

When construction was begun it proved to be necessary first to remodel the shoring bents, as the inner post on either side was so close to the steel as to be in the way of footing excavation. The lower sections of these posts were therefore taken out and the upper portions carried on sets of 8 x 16 timber stringers resting on short posts placed farther out (see falsework sketch in Fig. 1). Footing excavation for the protection walls was then carried out, by hand work, and extended well down into the boulder foundation. The damaged sections of bent 4 were cut away by oxy-acetylene torch, and the old concrete pedestals removed, before the new concrete was placed.

For concreting, storage and mixing platforms were

built under the end of the bridge, receiving concrete aggregates direct from cars on the track above. The materials went from storage to the mixer by gravity, and the mixed concrete was chuted direct to the forms. The chutes were made of wood, and the concrete (1 : 3 : 5) was mixed wet enough to flow easily. The total concrete placed was 473 cu.yd. at bent 3, and 584 cu.yd. at bent 4, a total of 1057 yd., weighing approximately 2200 tons. From the standpoint of protection, this is to be compared with 97 cu.yd., weighing 194 tons, in the four old concrete pedestals.

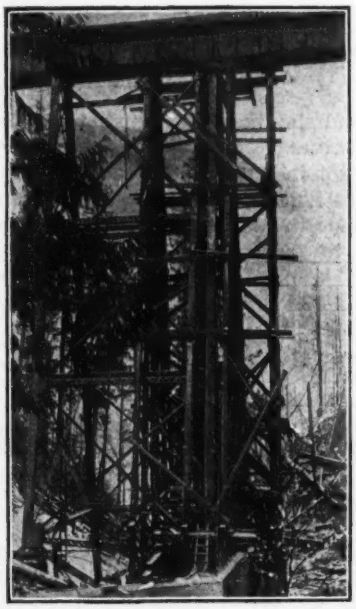


FIG. 3. LOOKING DOWN THE GORGE; PROTECTION WALL AT BENT 4

The writer is of the opinion that column protection for all structures carrying railroad track is of vital importance, and the engineer designing foundations in mountainous countries should have full data as to the slide characteristics or other destructive possibilities of the waterway or channel.

Similar column protection has been applied by the Great Northern to two other bridges in the Cascade Mountains where slide or flood damage is likely. This work, as well as that on Bridge 408 shown by the illustrations, was carried out by railway forces, under the direction of A. H. Hogeland, chief engineer, and O. S. Bowen, principal assistant engineer, Great Northern Railway Company.

It has been concluded by capable engineers that the menace of slides in the higher altitudes of the Cascade Mountains is largely due to the removal of valuable standing timber and to forest fires and other causes developing along the railroad lines, all tending to expose large barren snow areas on the upper slopes and leading to the formation of slide zones in the more precipitous ravines. These conditions affect the western slope of the Cascades more seriously than the eastern slope because of its greater steepness and smaller capacity for the runoff of flood waters. It may be anticipated that more slide trouble will develop in the future than has been experienced in the past, and protection work of the kind described may therefore have to be carried out on a larger scale than hitherto, especially on the western slope of the range.

Water-Power Development in Sweden

Water-power development in Sweden has been developed to the extent of 1,105,000 turbine horsepower, or 18% of the 6,200,000 hp. available, according to a report made by Albert Halstead, United States consul general at Stockholm.

Safety in Operating Traveling Cranes

RULES for the safe operation of electric traveling cranes, formulated recently by a committee of the Association of Iron and Steel Electrical Engineers, contain two points worth general notice. They prescribe that crane operation during construction or repair work should be governed by a special signal code prepared by the management, instead of by the ordinary manual or oral directions. Such special signals should also govern in all unusual lifts or crane motions, as when parts of machinery are removed or replaced, or when two cranes are worked together to lift one load. The special signals should be given by a designated person known by the operator to have the appropriate authority.

Another rule affecting repair or construction work relates to work done on or near crane runways. For proper safety of such work it is required that track torpedoes be placed on the crane runway rail nearest the cab, not less than 75 ft. away from the point where men are working on the runway. Two torpedoes should be used at each point, and the operator, on hearing a torpedo explode, should immediately stop his crane. Notification of work on or near the runway should be given to the crane operator before the work is begun, and a flagman should be detailed to ride in the cab of the crane, with the sole responsibility of looking after the safety of the workmen. This flagman is also the one to place the track torpedoes. The rules are published in the "Proceedings" of the association for 1918, together with the discussion upon them at the Baltimore convention, held last September.

Of the general rules included, the following are noteworthy: "A signal to stop the travel of a crane or the movement of any of its parts, by whomever given, should be obeyed," and "A motor should not be started, to make a lift, if the operator knows that an improper hitch has been made with chains or slings, or if hooks permanently attached to the crane fixtures are not properly adjusted." Another rule states: "It is not good practice to make side pulls. If they are permitted they never should be made by use of the ladle hoist," referring in this case more specifically to conditions in furnace buildings.

Durability of Piles in Intertidal Space

How far above low water are untreated wood piles protected by saturation? This question has been asked a number of engineers by the Forest Products Laboratory, at Madison, Wis. In tidal waters the portions of piles above mean low tide, although completely immersed only part of the time, may be practically saturated all the time. Wood constantly saturated with water is not subject to decay, and this fact makes the height to which saturation extends above low tide a question of considerable interest to the designing engineer. The opinion of most of the engineers asked is that untreated piling in water not infested with marine wood borers will remain sound indefinitely if cut off at half-tide. This height ranges in various ports from 2.3 to 4.5 ft. above low water. At certain places on the Atlantic coast piles cut off at the height of half-tide are still sound after from 50 to 100 years of service. Untreated piling is destroyed by marine borers more rapidly than by decay, and the information given would, of course, have no practical use where these organisms are active.

Diagram for Computing Band Spacing for Wood-Stave Pipe

For Pipe 1 to 20 Feet in Diameter, Under Heads of From 10 to 200 Feet and for Band Diameters of ⅜ to 1¼ Inches

By Willis T. Batcheller
Engineer, Municipal Light and Power System, Seattle, Wash.

THE accompanying chart is being used in the field for spacing the bands on the Cedar River pipe line now being constructed to supply water for the new 16,000-hp. hydro-electric plant of the City of Seattle. The entire conduit will consist of about 7500 ft. of 78-in. wood-stave pipe and some 2000 ft. of steel penstock. Of the 600 ft. of static head on the turbines 500 ft. occurs in the last 2000 ft.

Although the principles of design used for the band space are not new, the writer believes that the chart is.

In the design of wood-stave pipe the bands are proportioned to carry the entire strain. The band area is, therefore, equal to the area of the metal in a steel pipe having a joint 100% efficient. The equation for the band area per linear foot of pipe is then:

$$A = \frac{0.434HD12}{2S} = \frac{2.604HD}{S} \qquad (1)$$

and the number of bands per hundred feet of pipe is

$$N = \frac{260.4HD}{S\,a} \qquad (2)$$

The band spacing in inches is, therefore,

$$B = \frac{12}{N} = \frac{12SA}{2.604HD} = \frac{4.608SA}{HD}$$

D = inside diameter of pipe in inches
H = maximum static head on pipe in feet
A = area of band steel per linear foot of pipe
a = area of steel in one band
N = number of bands per hundred feet of pipe
B = band spacing in inches
S = allowable fiber stress in pounds per square inch.
0.434 = pressure per square inch per foot of head.

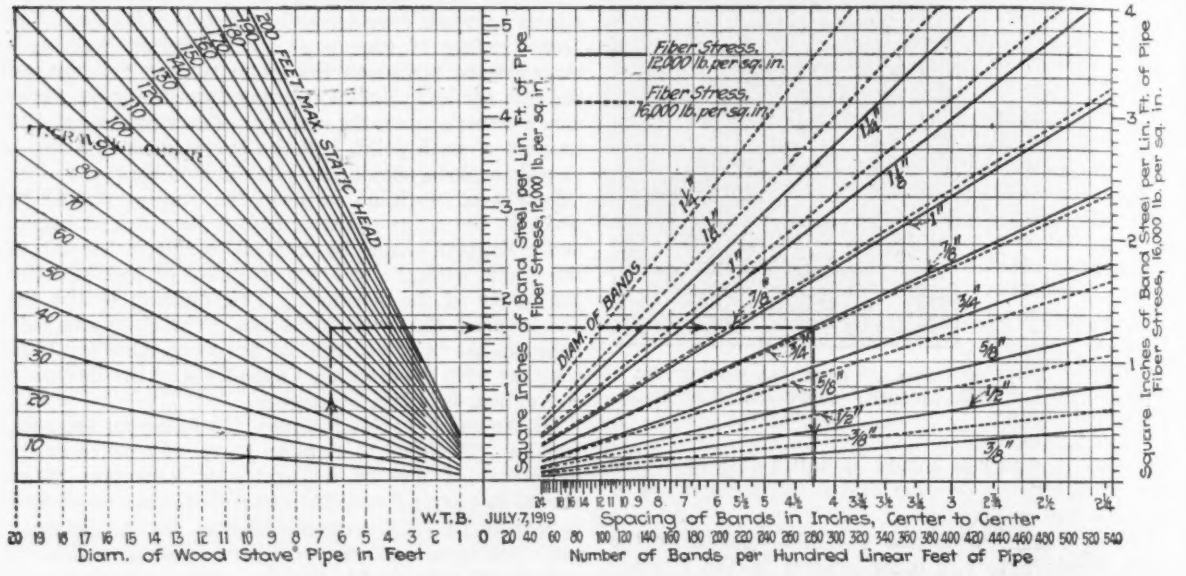
Substituting a fiber stress of 12,000 lb. per square inch in Eq. (1), (2) and (3), we have

$$A = 2.17 \times 10^{-4}\,HD \qquad (4)$$

$$N = 0.0217\,\frac{HD}{a} \qquad (5)$$

$$B = \frac{55{,}300A}{HD} \qquad (6)$$

Using the above equations, values were computed and curves plotted covering the ordinary range of conditions met in practice. The method of using the chart will be illustrated by an example. Given 6½-ft. wood-stave pipe with a maximum static head of 100 ft. and using


200 FEET MAX. STATIC HEAD
Square Inches of Band Steel per Lin. Ft. of Pipe
Fiber Stress, 12,000 lb. per sq. in.
Fiber Stress, 12,000 lb. per sq. in.
Fiber Stress, 16,000 lb. per sq. in.
DIAM. OF BANDS
Square Inches of Band Steel per Lin. Ft. of Pipe
Fiber Stress, 16,000 lb. per sq. in.
W.T.B. JULY 7, 1919
Diam. of Wood Stave Pipe in Feet
Spacing of Bands in Inches, Center to Center
Number of Bands per Hundred Linear Feet of Pipe

DIAGRAMS FOR SPACING BANDS ON CONTINUOUS WOOD-STAVE PIPE
The two diagrams mentioned in the text have here been combined in one by adding the dotted lines and also the second scale at the right for computations with 16,000-pound fiber stress

⅜-in. bands, what will be the band spacing in inches and the number of bands per hundred feet of pipe?

Starting at 6½ on the pipe-diameter scale, going up vertically to the intersection with the line representing 100 ft. of head, thence horizontally to the ⅜-in. band-diameter line and down to the lower scale intersection, gives a band spacing of 4½ in. and the number of bands as 282 per 100 ft. of pipe.

Although 200 ft. of head will be found to be the maximum ordinarily used for wood-stave pipe, any pipe for heads in excess of this amount may be computed by using one-half the head and multiplying the number of bands by two or dividing the spacing by two.

A similar set of curves was prepared, using a fiber stress of 16,000 lb. per square inch, in which case Eq. (4), (5) and (6) become

$$A = 1.63 \times 10^{-4}\,HD \qquad (7)$$

$$N = 0.0163\,\frac{HD}{A} \qquad (8)$$

$$B = \frac{73{,}728A}{HD} \qquad (9)$$

If values of fiber stress, other than those plotted, were used, the problem could be solved by means of either chart, and the resulting band spacing adjusted in proportion to the fiber stresses.

Paper Cylinders Used for Molds for Concrete Test Pieces

Substitutes for Heavy Steel Molds Are Light, Collapsible and Portable—Prove Acceptable on Government Work

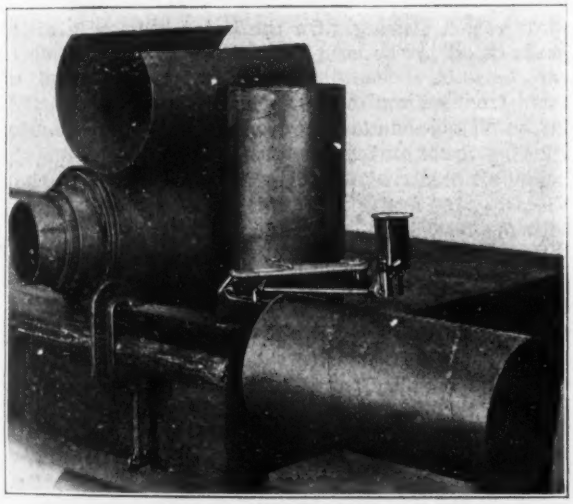
By Watson Davis
Assistant Engineer, United States Bureau of Standards, Washington, D. C.

TESTING concrete as made in construction work, and the linking of these tests with laboratory work and control are problems that confront the testing engineer or the engineer in charge of carefully designed reinforced-concrete construction. As an aid in this problem, the Bureau of Standards is using a light, collapsible, portable paper mold as the form in which to cast concrete test cylinders. The distinctive improvement in the mold is that it is slit lengthwise in order to allow nesting during shipment, and that it can be assembled at the job by lacing up with a stapling machine.

As the 6 x 12-in. molds weigh only 7 oz. each (one-fiftieth as much as ordinary steel molds, which weigh about 22 lb. each), and as they can be nested for shipping and easily assembled just before use, they make the taking of concrete test cylinders on the job much simpler than when it is necessary to use heavy and bulky steel molds.

These paper cylinders have been used by the Bureau of Standards in its work, and by the concrete ship section of the Emergency Fleet Corporation in testing the concrete used in the pouring of concrete ships and barges.

The accompanying photograph shows an assembled



ASSEMBLING PAPER MOLDS FOR TEST CYLINDERS

mold, a package of nested molds, and the stapling machine that is used to lace up the molds.

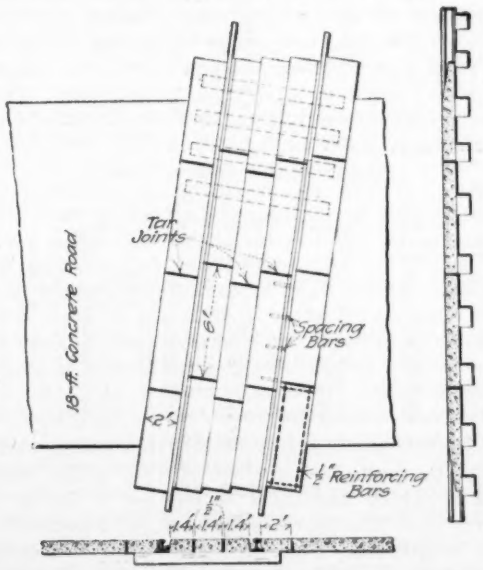
The mold consists of a two-ply cardboard cylinder, as usually manufactured, which is slit lengthwise, and then dipped in hot paraffin to make it waterproof. When nested for shipment 25 cylinders make only slightly more bulk and weigh about half as much as one steel mold such as ordinarily used in laboratory work. About twenty-five ½ in. wire staples, spread every ½ in., are used in lacing up the mold along the slit. The stapling machine weighs only 4½ pounds.

The molds are used only once, and can be left on the cylinder as a protection to the concrete during shipment to the laboratory. Comparative tests, using paper and steel molds, have been made, and show that the paper mold does not affect strength results. No paper caps for base and top are used, but a layer of neat cement paste placed in the bottom of the mold just before pouring the concrete, and a layer of paste on top, prevent loss of water and drying out of the concrete. These neat cement caps also provide satisfactory bedding surfaces during the compression test if they are ground smooth on a flat steel plate sprinkled with carborundum.

The cost of the paper molds is about 10c. each, and the stapling machine can be bought for about $12.00.

Sectional, Removable Concrete-Slab Railroad Crossing

SECTIONAL, concrete-slab railroad crossings are proposed for the road system of Wayne County, Michigan. The general design and layout of these crossings are shown in the accompanying illustration. Each of the sections used between the rails is 6 x 1.4 ft., with a thickness equal to the height of rail. Sections outside the rail are 2 ft. wide. Reinforcement consisting of ½-in. bars is used as shown, and tar joints bind the



REMOVABLE CONCRETE-SLAB RAILROAD CROSSING

sections together. Those inside and next the rail have projecting spacing bars which come in contact with the web of the rail, leaving clearance for the wheel flanges.

Surveys of the various railway crossings in Wayne County have been made, and the board of county road commissioners, of which Edward N. Hines is chairman, has suggested to the engineering departments of the various roads that they be permitted to install this slab construction at county expense, the county also to maintain it after installation. It is believed that this will make a much smoother and more serviceable crossing than the old planked crossing, and, at the same time, leave the crossing equally accessible for repairs. As yet no crossings of this type have been installed.

Operation Methods and Results on the Lindsay-Strathmore Irrigation District

Well Tests and Reconstruction—Operation Results of Well and Main Pumping Plants—Water-Hammer in Wood Pipe Lines—Repairs to Steel Pipes—Gravity and Pressure Consumers' Meters

By E. Court Eaton

Superintendent of the Lindsay-Strathmore Irrigation District, Lindsay, Calif.

SOME of the construction methods employed and difficulties overcome in the Lindsay-Strathmore Irrigation District, California, were described by the author in *Engineering News-Record* of Aug. 21, 1919, p. 348. This article will give some operating experiences and results obtained in 1918, the first season in which the new works were used. The supply is pumped from wells, is repumped, some being lifted still higher by a booster plant, and is distributed through pipes and two types of meters to the consumers, having previously passed master meters.

Well Tests and Reconstruction—When the irrigation season started in April, 1918, 30 wells were available, the other seven being in such condition that it was impossible to pump them—due, for the most part, to casing deformed while drilling was done. It was estimated, however, that the 30 wells would fulfill the requirements for the first season, when only a little over half the acreage in the district would be under cultivation and require water. During January, February and March, 1918, total of 1525 acre-ft. was pumped, used almost entirely for testing out pumps, filling and testing wood and steel pipe lines, canals and reservoirs. None of this water was sold for irrigation purposes. The average results obtained throughout the season by months are shown by Table I:

TABLE I. WELL YIELDS BY PUMPING

Month, 1918	No. of Wells Pumped	Pump Hours, Total	Total Pumped, Acre-Ft.	Av. Depth to Water During Pumping, Ft.	Average Head on Pumps, Ft.	Av. Discharge per Well, Sec.-Ft.
Jan.	8	.....	517	Not used for irrigating		
Feb.	11	.....	650	Not used for irrigating		
Mar.	8	.....	358	Not used for irrigating		
April	27	8,245	818	46.3	118.8	1.73
May	29	19,556	2338	46.4	124.3	1.445
June	29	19,786	2510	51.2	129.4	1.529
July	29	21,740	2740	50.7	128.3	1.525
Aug.	30	20,814	2420	51.4	133.2	1.405
Sept.	29	19,645	2090	53.2	129.9	1.288
Oct.	21	10,407	1110	53.2	129.2	1.290
Nov.	11	3,798	394	54.8	126.0	1.255

The actual average static head from the ground surface at the wells to the water surface in the low-level canal to which the water is pumped is 58 ft. The records show the poor results obtained compared with what is required. This condition is due to incomplete perforation of the well casings and insufficient well development, both causes combining to give an excessive drawdown in the wells and a consequent total head of over 125 ft. on the pumps, which were rated to give their maximum discharge at 100-ft. total head.

At the close of the irrigation season the district purchased a well rig, an air compressor and a gas engine, and the required tools, and in 1919 put under way the redrilling of the eight wells left uncompleted and also began perforating and developing the worst of the other wells in order to put them in shape to deliver the increased quantity necessary for the season of 1919.

The new wells are being drilled with casings of three sizes. A plain 18-in. casing is put down to a depth of about 50 ft. for a pit to take the pump. Below this a 16-in. perforated casing is driven as far as possible, followed by 12-in. perforated casing as far as required, about 175 ft.

The drilling with perforated casing is more difficult, owing to the sand coming in through the perforations, leaving the large boulders against the casing with the voids unfilled. As the casing is shoved down these loose boulders tend to rotate and thus to deform the casing. The smaller perforations instead of the larger cut made by the perforator also make it a more difficult matter to develop the well and clear out the perforations, but better results will ultimately be obtained than by attempting to perforate after drilling is completed.

Wells Blown Out With Compressed Air

An air compressor, capacity 140 cu.ft. per minute, is used, and the well blown out for two days through a 3-in. iron pipe, which is afterward used as an air lift to clean the sand out of the bottom of the well. The result of this treatment has been to improve the wells so treated; in some cases the discharge has been doubled at the same time that the drawdown has been cut from one-third to one-half.

One of the two makes of deepwell pumps used carries the load of the vertical shafting and runners on ball bearings run in an oil chamber, and the other has a water-cooled bearing. On the latter bearing, a cheap grade of oil can be used without trouble; in the other, care must be taken to obtain a suitable heavy oil, to avoid trouble from overheating. More oil is also used in the oil type, due to the construction of the bearing allowing the throwing out of oil.

The oil finally adopted has the following properties: Viscosity, 150 at 212° F.; cold test, 40 to 60; flash test, 530; fire test, 615; gravity, 25.3.

Power for operating the well motors is furnished by the Mount Whitney Power & Electric Co. from an outdoor substation on the southern boundary of the district's property, on which the wells are situated, and is metered on the low-tension side of the power company's transformers. The power thus paid for by the district includes the line losses in the 2200-volt distributing lines to the wells, which are as follows: 1.47 miles 2200-volt 4/0 copper wire; 2.02 miles 2200-volt 1/0 copper wire; 5.47 miles 2200-volt No. 6 copper wire. The power rate is one established in 1915 by the state Railroad Commission for large consumers, and consists of a monthly maximum demand charge of $2.70 per kilowatt, based on a 15-min. demand, plus an energy charge of 1c. per kilowatt-hour. Under this rate, and with continuous running at full load, it would be possible to obtain a rate of 0.625c. per kilowatt-hour, but under conditions of small storage and rains likely to occur at the beginning and end of the season, this advantage has not been obtained. Table II (see next page) shows the results of the year's irrigation season, from which the

TABLE II. WELL PUMPING PLANT OPERATIONS AND EFFICIENCY

Month, 1918	Pumpage, Acre-Ft.	Av. Current per Well Amp.	Consumption, Kw.-Hr.	—Power Cost— Per Acre-Ft. Kw.-Hr.	Per Acre-Ft. per Ft. Lift†	Plant Efficiency Per Cent.
Apr.	1175	9.82	247,200	1.129	1.996	55.8
May	2338	9.54	573,600	0.655	1.292	51.9
June	2510	9.16	616,800	0.644	1.221	51.9
July	2740	9.18	650,400	0.628	1.161	55.4
Aug.	2420	9.08	601,920	0.646	1.087	55.1
Sept.	2090	8.74	535,680	0.704*	1.545*	51.8
Oct.	1110	8.56	289,100	0.811*	1.635*	50.9
Nov.	394	8.57	12,000	1.017*	2.460*	42.4

*Includes 10 per cent. surcharge allowed to power company by Railroad Commission.
†Lift is head including friction.

plant efficiency has been worked out. This efficiency includes all losses in lines, the lighting of pump houses and other incidental losses.

The greatest difficulty is, of course, experienced in the months at the beginning and end of the season, when a period of several days of rainy or even cloudy weather will change the demand for water.

Unfortunately, the location of canals, flumes and pipe lines is such that any large storage is impossible, although a certain amount of relief is obtained by storing water in the canals and flumes by breastgates.

Owing to the distance of the wells from the district, any increase or decrease in the supply takes about eight hours to affect the distributing system, and the matter of estimating and anticipating the flow has been one that has required considerable attention. Frequent power shutdowns, due to overloading of the power company's system and restriction of the use of oil for steam auxiliaries during the war, have increased this difficulty.

Changes Due to Increased Drawdown in Wells

The increased drawdown in the wells made it necessary to add 10 ft. of pump column on 18 of the well pumps, and an additional 10 ft. of suction pipe was put on 26 of the wells. Ten feet of submergence of the suction pipe gave freedom from air troubles due to entrained air in the water flowing from the perforations into the well. Daily records were kept giving the time of starting of each pump, with pressure-gage readings, depths to water and ammeter readings.

A chief operator and two helpers, each provided with saddle horses, took care of the 29 wells pumped. With a more continuous power service, one of these men might have been dispensed with, but a momentary fluctuation in voltage was sufficient to shut down some or all wells, requiring two hours' time to make the rounds and get all the wells back into service, and additional help had to be employed for this emergency. Pumps have to be carefully started to avoid water-hammer which was not completely taken care of by the relief tower.

Wood Pipes—These pipe lines, after final completion by the contractor, have been entirely satisfactory and have given no trouble with the exception of a few minor leaks, generally occurring at the junction of the steel fittings with the wood pipes. The pipes have been subjected to a certain amount of water-hammer which must have been severe when 30 wells were suddenly shut down owing to power going off the line. No opportunity occurred for the measurement of this with all wells on the line, but during the latter part of the season, when three wells only were running, a few were taken.

On stopping one well of the three, the pressure dropped from normal (26 lb.) to 14 lb.; in 3 sec. more it had risen to 28 lb. and then fluctuated between 28 and 22 lb., in decreasing swings of the needles, until normal was finally reached in 85 sec. from the time the well had been shut down. With two wells still running, the third well was thrown on with the gate valve wide open. The pressure rose in ½ sec. from 26 to 34 lb. and in 1½ sec. dropped to 16, then gradually rose, with slight fluctuations of not over 1 lb., to 29 lb. in 8 sec., and from here fluctuated slowly until in a total of 90 sec. it had returned to normal.

Water-Hammer—When it is remembered that this occurred in a section of pipe 200 ft. away from the well, with only three wells running with low velocity in the pipe, it will be realized that considerable strain must have been put on these lines when they were running at their maximum values. However, no serious leaks resulted, although there were a few places where minor leaks always broke out immediately after a shutdown had occurred. The relief tower undoubtedly helps somewhat, but to give full protection, a larger riser to the tank would have to be provided and provision made to take care of overflow, with consequent wasting of water.

Pipes Have Withstood Conditions Well

Further and more accurate determinations of water-hammer, with more suitable equipment, will be made this year. The results from operation have shown, however, that the pipes have stood very well the conditions to which they have been subjected. Air and vacuum valves have been installed at all dead-ends and principal elevations.

Venturi Meters in Wood Pipes—Two 48-in. venturi tubes had been placed, one in each main wood line, to measure the total flow from the wells. As the meters were located near the discharge into the canal, where only 6 or 8 ft. of head was available, the float-operated types were installed. For a short time these worked satisfactorily, but soon the openings from the throat and inlet to the tubes became clogged, as there was not sufficient head to allow these to be blown out. The result was that the recorders did not respond rapidly to changes in flow, in some cases taking 15 min. or more after a shutdown to return to zero. These openings will be enlarged. It would probably have been better to locate these tubes at points of higher pressure and use pressure-type instruments.

Low-Level Canal Lining—This canal had been gunited, and, in trimming, allowance was made for 1 in. thickness of lining. Due to the uneveness in finishing, the resultant thickness of lining was from 1½ to 2 in. in some locations. The junction of the 1 : 1 side slopes with the bottom could not practically be made a sharp corner, but when finished took the form of a rounded fillet. These two factors combined to cut down slightly the sectional area of the canal, but there will be no difficulty in getting the required maximum flow (75 sec.-ft.) through the canal. Measurements of flow in the canal, made with a current meter, gave a value of Kutter's n of 0.01699, or very close to that which had been assumed, 0.0175.

The rough finish of the surface of the lining makes it particularly easy for algæ to obtain a hold, and the elimination of this has entailed considerable expense, so that the growth would not find its way into the pipes and clog up meters. It is felt, however, that with the experience gained during the season just past this

item will be considerably reduced during 1919. The results obtained are described in an article appearing in *Engineering News-Record* of Feb. 20, 1919, p. 382. The canal will ultimately be covered. The lining of the canal has given excellent results, only one small breakage occurring, due to heaving of the bottom where sufficient tamping had not been done.

As there is no storage at the lower end of this canal, and to prevent loss by waste, radial breastgates were provided at one-mile intervals, to hold back the water in case of a power shutdown. These will be provided with solenoids so arranged that they can be immediately lowered from a central point, making a considerable saving in time and labor, and also a saving in loss of water.

Main Pumping Station—Beyond a few minor repairs, this station gave no trouble during the season. The units installed and the guaranteed efficiencies are as follows:

Pumps					
Number	Size, In.	Capacity, Gal. per Min.	Head, Ft.	R.p.m.	Efficiency, Per Cent.
3	18	10,000	160	1175	80
1	12	4,000	160	1175	79
2	8	2,000	160	1175	73

All are direct-connected to induction motors. As in the case of the wells, power is supplied from an outdoor substation at the same power rate as for the well system. The actual results obtained are given in Table III. The plant efficiency includes all losses. The use of lights, heaters, etc., is included.

TABLE III. OPERATIONS AT MAIN PUMPING STATION

Month, 1918	Pumpage, Acre-Ft.	Consumption, Kw.-Hr.	Cost of Power per Kw.-Hr., Cts.	Head, Ft.	Cost of Power Cts. per Acre-Ft. per Ft. Lift	Plant Efficiency Per Cent.
Apr.	1175	297,000	1.06	159.2	1.681	64.6
May	2338	600,000	0.683	154.7	1.135	61.7
June	2510	609,600	0.682	152.3	1.084	64.7
July	2740	636,000	0.650	158.3	0.951	70.0
Aug.	2420	528,000	0.684	158.3	0.943	74.4
Sept.	2090	573,000	0.725*	164.1	1.211*	61.3
Oct.	1110	273,600	0.817*	159.2	1.261*	66.4

*Includes 10 per cent. surcharge allowed to power company by Railroad Commission.

Having units of several different capacities was a great convenience, this allowing various flows to be handled with maximum efficiency.

Two operators—12-hour shifts each—took care of this station, and during the winter season the plant was handled by one man living in a nearby residence. During this time alarm circuits have been wired up for notification in case of stoppage or overflow.

Boosting Station El Mirador—This station provides an additional 160-ft. lift to take care of 2500 acres in a high section. As only 350 acres were under cultivation during 1918, the cost of operating this plant and district was out of proportion to the revenue received. A considerable additional area will come in during the present season, which will relieve matters somewhat. No difficulties were experienced at this station.

Distribution System Repairs—The pipe lines, which are of light, riveted steel, were filled with water in February, 1918, after they had been laid an average of six months. They were filled very slowly to avoid sudden shock to the pipe. A number of cement bands had been used at the junction of main and branch lines. On applying the pressure a number of leaks developed, although the greater number did not show up for several weeks. These leaks were probably very small at the beginning, and the ground, being very dry, absorbed the water without its showing on the ground surface until the leak had cut itself to a large leak.

In all, up to Nov. 30, 1918, about 500 leaks developed, or five per mile of pipe. Most of the first leaks that showed up were in cement bands put on to join up sections of main and branch lines, but, considering the number of bands put on, these made up a relatively small number.

Thrust blocks of concrete had been put in at all elbows and almost all tapered fittings, and in a few cases leaks developed due to insufficient bracing, or a small leak would soften the ground, allowing movement of the block. These also made up a relatively small percentage, as did cases where rivets had not been securely driven or had been left out altogether, the greater number of leaks being at the slip joint of the pipe. The majority of these leaks were due to too much "belling" of the butt ends of the pipe to facilitate the laying, and consequent open space where the dip was ultimately blown out; and some, especially in the larger pipes, where the "spuds" used in fitting the joints together had been left in too long after the pipe had partly cooled. A number of the leaks in these slip joints may have been due to the fact that the pipe was laid at the hottest time of the year, after the pipes had lain above ground and had been exposed to a temperature of 100 to 115° F. They contracted after being covered up, causing loosening up at the slip joints. Some of the leaks in the slip joints were caused by forcing a section of pipe down into the trench to make a slight vertical bend, after the joint had cooled, to conform to inequalities in the grading of the ditch.

Leaks Calked and Cement Bands Applied

The method employed in making repairs was the same for all sizes of pipe. After a section of wrapping was dug out and taken up, the leak was calked with redwood splinters, and a cement band, 2 in. larger in diameter than the pipe and 8 in. long, was put on and calked with neat cement. Where possible, this was done with the full head of water on the pipe. On the smaller pipes, up to 12-in. diameter, this worked all right, but on pipes larger than this the bands had an increasing tendency to give trouble, and there were cases where a leak had been repaired three times and then failed to hold.

An investigation of these bands showed that on the larger pipes, up to 26- and 36-in. diameter, a cement band of 16-gage iron had been used with the longitudinal seam on the band made up, in some cases, of 5¼-in. stove bolts. Some of these pipes are subjected to heads of 60 to 70 lb., and if the cement is considered as a calking medium only—as would be the case if a crack developed—this band is strained beyond the ultimate strength of the steel. An examination of some of these showed a crushing of the plate outside the bolts. Cement bands now being put on are of steel of the same gage as the pipes, with a longitudinal seam so bolted that it has a joint efficiency of 70%, the same as called for in the specifications for the pipe. The larger pipes are now being repaired with a reinforced-concrete collar 6 in. thick, and no further difficulty has been experienced. The average cost of repairing each leak is $10, including 10% overhead charges.

Portable recording pressure gages were purchased,

and have been located at various points on the system, including dead-ends, and have failed to show any indication of water-hammer. Particular care is always taken in operating line valves to open and close these slowly.

Method of Serving Water—The main riveted steel pipe line laid in the road is tapped at a point opposite that to which the grower requires his supply. This tap is made by means of a 3-in. brass saddle which is bolted on the riveted steel main, and a 3-in. wrought-iron pipe connects with this and runs to the property line, terminating in a 3-in. gate valve. This gate valve is the property of the irrigation district, is kept locked and adjusted only by the "zanjeros," or water tenders, either to cut off the supply altogether or give not more than the allotted rate of flow.

Next to this is installed a second 3-in. valve which is the property of the grower, and is used by him in case of an emergency, to cut off or cut down his flow. Next to this valve is placed the water meter by which the consumption is measured, and by means of which the grower is billed monthly for water. These meters are installed by the irrigation district but are paid for and are the property of the grower.

Consumers' Meters—Two types of meters are in use—one, commonly known as the "gravity" and the other as the "pressure" type. The "gravity" meter consists of a vertical spindle terminating at the lower end in a short screw impeller, the upper end of which is connected to a gear train registering acre-feet on an inclosed dial. The spindle is supported on ball bearings in a circular, galvanized-iron "can" with vertical baffles, and the water flows over a partition down through these baffles, rotating the impeller and thus recording the quantity of water used by the grower. The whole is set in a vertical, concrete standpipe. Water is led in through one side, passes through the meter and then out on the opposite side.

As this meter is open at the top, it is only installed at locations where not over 6-ft. head is required to supply the static and friction head on the grower's property. Where inequalities in the land and friction in the grower's pipe lines are such that a greater total head than 6 ft. is required, these meters are not installed, due to the cost of the concrete stands housing the meters being too great, and the labor of setting up at heights over this being excessive. Two sizes of this type are used, one having a maximum capacity of 25 and the other of 50 miners' inches. The miners' inch is taken as being equivalent to $\frac{1}{40}$ second-foot.

The meter stands consist of sections of ordinary concrete pipe; 26 in. for a 25-in. meter, and 30 in. for a 50 miners'-inch meter. The loss of head in friction in these meters is very small—not over 0.5 ft. at rated maximum flow. The meters are especially designed for irrigation purposes where extreme accuracy at very low flows is not required at the low rate at which water is charged, compared with the rate for domestic water.

The "pressure"-type meter consists of a standard inclosed water meter and is used at points where a greater head than 6 ft. is required to cover the head due to elevation in the land and friction in the growers' pipe lines. The meter is an inclosed turbine meter, having a rubber impeller rotating between fixed diffusion vanes. A number of different makes of these meters were tried. The best satisfaction has been given by one having a long impeller with a fair-sized clearance between the impeller and the stationary ports through which the water flows to the impeller. This meter, although not designed for irrigation purposes, has been developed to handle water carrying sediment. The manufacturers make an especially designed gear train, and recording device, registering in acre-feet. Up to date this meter has given good satisfaction.

With the other pressure types the impeller was small and had very small clearances provided between fixed and rotating parts to give accuracy at all ranges, with the result that even a small quantity of sand was sufficient to lodge a few grains between fixed and moving parts, resulting in breaking of the impeller. One manufacturer redesigned his type of meter, removing the fixed diffusion vanes and improving the meter somewhat, at the sacrifice of accuracy at low flows, but a need is felt for an inclosed irrigation meter of reasonable accuracy having a sufficiently rugged construction to withstand small quantities of sand and sediment, and having a much smaller loss of head than those in use at present.

The loss of head in friction in the meters of this type in use at present is over 40 ft. at rated discharge, so that sufficient pressure must be available in the line to supply the losses in the meter in addition to the static and friction heads occurring in the grower's system.

Distribution of Water—An attempt was made at the commencement of the season to allot the water in the order of application, the grower being allowed the equivalent of what would give 1¾ acre-ft. per acre in one irrigation season of six months. The method employed was for a grower to make an application, giving the acreage and the length of time it would require him to complete this irrigation. When the time had come for a grower's irrigation to start, one of the district's "zanjeros," or water tenders, opened the district 3-in. valve at the property line and timed the grower's meter with a stop watch, setting and locking the valve so that more than this flow could not be taken. No fixed schedule was possible, however, for the 1918 season and alterations and adjustments had to be made from time to time.

This condition was due in part to (1) the shortage of water in the past few years, so that some growers required more water than others to wet up the land; (2) to the fact that salt had appeared in the old individual wells before the district had been completed, and an increased quantity was needed to wash this out of the soil; and (3) the high returns expected from corn during the year 1918, which resulted in a good deal of this being planted after the irrigation season had started. The principal reason why no fixed schedule could be followed was the poor power service, due to war conditions, and as it was impracticable to have any large amount of storage on the system, schedules could not be carried out and the growers' time allotment would have to be extended, throwing out the whole schedule.

The system is designed to supply a quantity of water giving a duty of water of 1¾ acre-ft. per acre, on the basis of a six months' irrigation season, and allotments were made on this basis. But it is more economical to allow the grower to use water at three or four times this rate, and get through his irrigation, the saving

occurring in lowered loss from evaporation of water from the soil.

A chief water tender and two "zanjeros" handled all the services. A card was kept for each irrigator. These were filled out at the office and turned over to the "zanjeros" in the order received. After water had been turned on, the cards were filed away under date due to be turned off, so that an exact record of the quantity required every day by each irrigator could be kept and the same quantity of water turned on every day as was turned off.

Growers take water from meters, and distribute, in most cases, through concrete pipe lines with hydrants at each row. In general, it is found more economical in handling water not to carry it in furrows further than across 10 acres, from one pipe line. Trees are spaced approximately 20 ft. apart. Navel oranges are picked in November, and Valencias in April. A crop of 10 boxes of the oranges per tree is considered a large crop.

The irrigation season for the year 1918 started Apr. 18 and ended Nov. 30. The total quantity of water sold during this period was 13,157 acre-ft. The total acreage in the district is 15,575, and of this 7904 were under cultivation during the season of 1918, divided into 7271 acres of oranges, lemons and grapefruit and 633 acres of corn, grain and vegetables. This gives a duty of water of 1.66 acre-ft. per acre.

The cost of the water for the 1918 season was $77,662, or $5.90 per acre-ft. to the grower.

The water is suitable for drinking purposes, as shown by frequent tests made by the State Board of Health, and the above figures include water used the year around for domestic purposes.

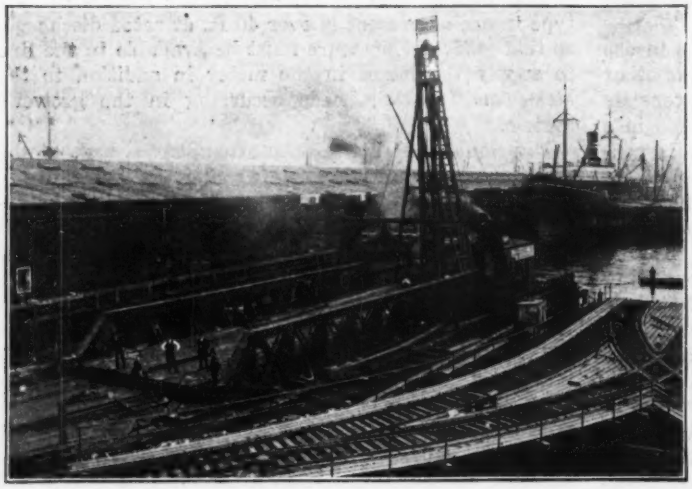
The system has been entirely satisfactory. It has been exceptionally free from repairs due to defects always to be expected in the first season's operation of a system having nearly forty individual pumps and motors.

The men employed to handle the pumps and distribution of water were all men from the towns in the vicinity of the district, and a great deal of credit is due them for the interest taken and for their coöperation, which were essential in making a success of the first irrigating season.

Move 200-Ton Transfer Bridge on Pontoons in New York Harbor

PONTOONS, one permanent and the other adjusted for the occasion, were used to float a 200-ton steel transfer bridge from the old site alongside of Pier 38, Atlantic Basin, New York City, to the new site between the adjacent Pier 37 and Pier 38. The work is at the Atlantic terminal of the New York Dock Co. As shown in the view, a new approach with tracks leading to the transfer bridge from two directions had been built before any of the moving operations started on the pontoon proper.

As is customary in such structures, the outer end of the bridge is supported by a pontoon with adjustment devices for varying the elevation of the outer end of the bridge to accommodate differences of elevation in the carfloats that may be brought to the bridge. In order to move the transfer bridge another pontoon was filled with water and placed under the inner end of the structure at low tide. The anchor bolts there were cut with a gas flame and the rising tide, together with the increasing buoyancy of the pontoon, due to the siphoning out of the water, raised the bridge from its old seat and left it floating free to be moved as required.



CAR-TRANSFER BRIDGE BEING LIFTED BY PONTOONS FROM OLD LOCATION

BRIDGE JUST BEING FLOATED INTO NEW POSITION

In order to steady the structure, guy lines were fastened at the corners of the bridge and led to the top of the piledriver nearby. The engine of the piledriver was then used to move the structure, lines leading to the adjoining piers having been put out in all directions from the winches, and the short voyage was accomplished by pulling and hauling on these lines.

It required 29 minutes to move the bridge from its old location to the new. After it was placed in its new position, the falling tide and the refilling of the pontoon caused it to drop on to the new bridge seat, and the new anchors were placed and fastened as soon as possible, leaving the bridge in proper position for operation at the new site.

The work was done by the Robbins-Ripley Co., under the direction of Robert Hoppen, Jr., chief engineer of the New York Dock Co., but the details of the work were under the direction of M. J. Weigand, principal assistant engineer.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Designs for Rondout Creek Bridge Compared

Sir—Your presentation of the comparative designs for the Rondout Creek bridge, in your issue of Aug. 14, has been read with interest, and the engineering profession should certainly appreciate the opportunity of examining comparative studies of this kind. There may be more valuable instruction given in the form of reasons why a certain design was rejected than would be given by the most careful description of the accepted design.

In the present instance the writer fails to discover, after reading the article, any satisfactory reason, from the standpoint of good engineering, which would have made necessary the change from the original design. As the study of the new design indicates that one of the main piers will be placed in the same location as the main pier of the original design, the stability of which was questioned, it is to be regretted that the type of foundation which is now proposed under this pier should not have been shown. From a casual inspection it appears that the loading on this pier will not be materially lessened, and it is difficult to understand what modification of the foundation is now proposed which would not also have been considered for the original design.

The writer believes, also, that most engineers would assign considerable bearing value to the reinforced-concrete mattress, 13 ft. in thickness, resting on sand and gravel material and inclosed by heavy concrete sheet piling extending about 15 ft. below the bottom of the mattress and completely inclosing the bearing material. It is assumed that the danger from scouring has been eliminated by the construction of the bulkhead shown, or otherwise provided for.

With regard to the appearance of the two designs, the first has a certain symmetry and a graceful outline which satisfies the eye. From the standpoint of cost, comparative figures are not given, but it will be the writer's guess that the added foundations and masonry work in the second design will make it exceed considerably the cost of the first design.

W. E. BELCHER,
Engineer, American International Ship-
Hog Island, Penn. building Corporation.

Supports Principles of Plumb Plan

Sir—Perhaps one may be pardoned for failing to see the logic of your editorial on the Plumb plan. Industry has always been "autocratically" managed by the employers; to be managed by the workers is a different matter, evidently.

The Plumb plan eliminates the capitalist—gets rid of the exploitation which is graven in the history of the railroads of the United States from the days of Jim Fiske to Mellen.

And is it such a wonderful thing that those who run the railroads for the capitalists should run them for the people, and those who manage them for the capitalists should manage them for the people?

Under the Plumb plan the management is under the direction of 15 persons:

Five represent the whole people, the Government.
Five represent the managing, directing officials.
Five represent the railroad workers.

You say the last five will control the other ten. How?

Through the votes of the two million workers on the railroads. But how about the twenty million voters in other walks of life?

And the control is to last 100 years.

Mr. Plumb says in the current issue of *The Nation* that the bill reserves to Congress the right to terminate the arrangement at any time, for cause. And, anyway, it is a bill before Congress. Is a bill pending in Congress unalterable, like the laws of the Medes and Persians or like Mr. Wilson's League of Nations?

Cannot the bill now before Congress be altered or amended to safeguard the control of the whole over the part?

The principle is good, and it ought not to be impossible to apply it with sufficient safeguards. Or is your opposition simply against taking the railroads from the control of the private owners?

The proposition is "Bolshevistic," "Socialistic"—of course it is. Shall we be scored by words?

"May we not" look abroad and see that Socialism is coming on fast?

After all, engineering is not bound up with capitalism—and the engineer is more appreciated in Bolshevic Russia than in the United States. THOMAS FLYNN.

New York, N. Y.

[Another letter supporting the Plumb plan has been received. It is signed "R. R. Engineer" and was mailed from Flushing, N. Y. If the author will send his name, we shall be glad to print the letter.—EDITOR.]

Coöperation or Competition Among Engineers?

Sir—Among all the talk about what must be done to obtain the rewards for engineers commensurate with their services and intellectual attainments, and to make of the engineering profession a closely knit group of citizens allied for the development of common interests and for the fulfillment of citizenship obligations, there is one word that must be spoken again and again, that must be written so often that it will be ever before the eyes of engineers, that must be present in our minds as a perpetual guide—and that word is coöperation.

No one denies that there are great advantages to be had by a coöperation of allied interests, but in making a practical application of the term to the engineering profession engineers at times seem strangely backward. Whether this is due principally to indifference, to ignorance, or to an absolute incapacity to recognize the truth and follow it, cannot be determined yet, and until it can be and has been determined it is impossible to say which of these possible explanations is the cause of incidents detrimental to the development of real coöperation, such as the one recounted here.

The commissioners of a certain county were about to approve a bond issue of several million dollars for highway construction. Among the various provisions was one increasing the salary of the county engineer

by a multiplier of about three. Such a salary was by no means too large for the active administrator of such a fund, but unfortunately there were a number of other engineers in that county who were making much less than the salary proposed for the county engineer. When it was announced that it was proposed to establish such a salary for the county engineer, some of the smaller fry promptly pronounced the salary too high. The county commissioners were puzzled but naturally gave deciding weight to the bushwhackers. Here were citizens who were in a position to say what engineering services were worth who declared that one of their number was to be overpaid.

Of course, if the county engineer's salary were kept down, so would be the salaries of district engineers and resident engineers and instrument men, and, furthermore, a lower scale would have the effect of keeping down the salaries of engineers in municipal work and the fees of those in private practice. The commissioners were also impressed with the business acumen of these engineers. "Here," they said, "are men who don't care how little they make; in fact, they insist on being paid less than the public is willing to pay them. How public-spirited! How unselfish!" And they proceeded to reduce the proposed salary. Verily, if any engineer throws a brick at a proposed increase in the salary of another engineer, the brick will rebound disastrously to the thrower.

Coöperation means more than mere membership in an association and more than mere assistance lent to engineering activities; it means a practical, unselfish, broad-minded, shoulder-to-shoulder attitude on all engineering questions. Anything less, and the engineering profession will fall far short of the goal it hopes to reach.

C. E. DRAYER, Secretary,
Chicago, Ill. American Association of Engineers.

Enunciates Need for Pavement Design

Sir—As an engineer, engaged for several years past in the "design" and construction of hard-surface or rigid pavements costing from $25,000 to $100,000 per mile, I have followed with a great deal of interest the agitations and controversies appearing in *Engineering News-Record* on the subject of "design" of pavements, thickness of slabs, etc. I am encouraged more and more to believe the truth of a statement made by myself some five years ago, that there is no such thing as design of pavements in use today, that the pavement sections are guessed, and that the thickness, stiffness and rigidity of a pavement slab as now constructed are but the engineer's personal estimate of a sufficient structure, based upon his best judgment or on the performance of similar structures previously built, modified by a more or less generous factor of ignorance.

Attempts are made to regulate the loads coming upon or passing over a pavement structure, yet not one of these pavement structures is designed for a definite maximum load, and nobody can state with any accuracy what weight is a safe load to permit on the structure.

Tests are made with indefinite purpose, and at once each paving-material interest bursts forth in loud acclaim that the tests clearly prove its material to be the only one for the purpose.

For ten years engineers have been proclaiming their lack of knowledge of pavement design, and more loudly today than ever before. Protestation will not dispel ignorance. Enlightenment alone is the antidote. Why, then, cannot these truths be sought out and coördinated, to the useful purpose of designing our pavement structures in as efficient and economical a manner as our bridges and buildings are now designed?

The Federal Government maintains departments for technical investigations and research; many states support engineering experiment stations, all of which could very profitably expend part of their efforts in seeking those principles which must be fundamental to the actual design of a pavement structure.

Pavement design must be based upon a knowledge of the physical characteristics of soils supporting pavements, and the distribution and magnitude of the bending and shearing stresses developed in the loaded slab, as well as the physical characteristics of the material of which the slab is constructed.

When these truths are known and made usable, the little man with the side whiskers and market basket can declare dividends on his highway investments and can tell his neighbor what weight of load will be permitted upon his property.

This country is spending no less than a million a day on pavement construction, as well as other millions in maintaining road improvements which have been inadequately conceived and corruptly born. Can it afford to continue the present hit-or-miss methods when the expenditure of a few hundred thousand dollars in well directed effort might permit us to build roads that will last longer, serve better, and, in the end, cost less?

Not before the use of airships becomes universal will the need for this enlightenment be wanting.

South Bend, Ind. D. MOOMAW,
Road Engineer, St. Joseph County, Indiana.

Specify Kind of Bidders, Says Engineer

Sir—"A Practical Engineer" in a letter to the editor, issue of July 3, p. 38, protests against letting a contract to the lowest bidder if such bidder is inexperienced. The solution is to specify the kind of bidders desired, in the same way that the kind of material is specified, in order that the low bid may be accepted. The rejection of a low bid is almost invariably a cause of trouble. The object of specifications is to have the work completed in a satisfactory manner, and it is just as necessary to specify the experience, capital and equipment of the contractor as it is to specify the quality of material he must use.

Topeka, Kan. LLOYD B. SMITH,
Topeka Engineers' Club.

[With Mr. Smith's letter was inclosed a bidding blank on which contractors are required to furnish information regarding their credit, previous experience on similar work, and a list of equipment they will employ.—EDITOR.]

Status of United States Housing Corporation

Sir—In *Engineering News-Record* of Aug. 21, p. 393, under "News of the Week," is an article entitled "Bill Proposed to End Housing Corporation." The second sentence reads as follows: "Its [the United States Housing Corporation's] abolishment is advocated on the ground that it was created as a wartime measure, and

Chairman Langley, of the public buildings committee, finds ample justification for its abolishment."

Upon first reading of this article it would seem that you have passed snap judgment and accepted the report of the public buildings committee through its chairman, Mr. Langley, which report was written without anyone in the Housing Corporation being invited or given an opportunity to be heard with reference thereto. I doubt that *Engineering News-Record* intended to infer what it does, and that it really intended to mean that Chairman Langley *claims* to find "ample justification for its abolishment." However, the article gives the impression that the Housing Corporation has been profligate and should be abolished.

The statement that the Housing Corporation is being perfected on a permanent basis, that the personnel is even now being augmented, and that the salaries have been unnecessarily advanced, cannot be substantiated by facts. Every member of the Housing Corporation realizes that it was organized to meet a war emergency, that the work which it has been carrying on since the armistice was signed is for the purpose of salvaging as much material and labor as possible for the United States Government, and that upon completion of the houses and all work connected therewith the houses will be put up for sale and the Corporation closed out as speedily as possible. The personnel has steadily decreased, and no new members have been taken on except to fill vacancies of those who have resigned to accept permanent and more lucrative positions. Where salaries have been advanced there has been a corresponding increase in duties and responsibilities.

When the armistice was signed the Housing Corporation had 97 projects in various parts of the country in stages from design to partial completion. Upon cessation of hostilities steps were taken to conserve funds, and 70 projects were abandoned. Of the 27 projects which were continued, nearly all were curtailed. Work was continued on the 27 projects (1) because it was apparent that a greater salvage value could be secured by carrying them to completion than by abandoning them; (2) they would have large peace-time value for the Army and Navy.

The only reason why any member of the Housing Corporation will be opposed to H. R. Bill 7656 is because he believes it will be contrary to public interest. Congress, by an amendment to the present housing act, has already provided for the rapid closing up of the affairs of the Housing Corporation and the selling of its houses and lands. This is being most expeditiously done, in accordance with the present act, by the United States Housing Corporation. The transfer to any other department would involve loss of time, great delay and endless expense to the Government. The present officials are now acquainted with all the details, and new organization would, of necessity, have to become acquainted with all these details and information.

Upon publication of H. R. Bill 7656 and the report of the committee on public buildings and grounds, L. K. Sherman, M. Am. Soc. C. E., president of the Housing Corporation, wrote to the Hon. Burt M. Fernald, chairman of the Senate committee on public buildings and grounds, Washington, D. C., requesting that the Senate immediately investigate the Housing Corporation because of the slanderous attack in the report of the House committee under Mr. Langley. On Aug. 15 Mr. Sherman wrote to Senator Fernald, giving detailed information on certain parts of his letter of Aug. 2. Irving E. Macomber, vice-president of the Housing Corporation, on Aug. 2, wrote to the Hon. John W. Langley, chairman of the committee on public buildings and grounds, House of Representatives, Washington, D. C., requesting that the House investigate the Housing Corporation. Every member of the Housing Corporation welcomes an investigation, even though it means that he must put in considerable overtime in order to get out the detailed information requested by the Senate and by the House.

On p. 347 of the same issue of your journal is an editorial dealing with the charge of profiteering by the cement companies. This editorial treats the question in a very fair and honorable manner, and I wish to congratulate you for the equitable treatment you have given the subject.

If you had given the United States Housing Corporation the same consideration that you did the cement companies, the impressions conveyed in the article entitled "Bill Proposed to End Housing Corporation" would be vastly different.

CHARLES E. HENDERSON,
Principal Assistant Engineer, United States Housing Corporation.
Washington, D. C.

Army Needs Better Psychology More Than New Organization, Says Correspondent

Sir—Your issue of Aug. 21, pp. 358 and 346, indicates that the perennial fight over the organization of the military establishment of the United States is again in full swing, this time in the arena of Congress.

The opinions on the subject furnished in the issue in question by the "engineer thoroughly familiar with the military establishment," as well as in your editorial thereon, are distinctly interesting and instructive. It is to be hoped that other opinions will promptly come forth, more especially opinions formed from actual contact with the workings of the military establishment both here and abroad during the recent war, together with specific sustaining facts when these are needful or useful. The subject is broad, vital and many-sided, requiring for effective understanding thorough consideration from many angles as well as careful analysis of many specific facts. Discussion should not be to the end of arraying the various elements involved on the old familiar lines of class, departmental, clique and personal interests, but to the end that this vital problem should be attacked on broad, intelligent and constructive lines. The Army bill should be framed with no unfair or enervating distinctions, but so that rank and authority shall be determined and conferred as far as possible on the basis of ability to perform, and not unduly on the basis of blind vested right or automatic rule of seniority.

Much sympathy will be found with the opinions of both the communication and editorial comment as to the features of the Army bill discussed. Giving the line a monopoly of the general rank smacks somewhat of the union spirit and perhaps has its origin in the same purpose that would bar civilians from rank and functions for which their qualifications and experience peculiarly fit them, to make place for regular Army officers less

qualified—often not qualified at all—for the functions in question.

However, experience both at home and abroad indicates that the basic trouble with our military establishment is not so much in its legal composition as in the multitudinous defects of its operation. A perfect system can be hopelessly debauched by incompetent and unfair operation, while an imperfect system can secure good results if it is intelligently administered and loyally served.

Apparently, the A. E. F. functioned for nearly a year under the old bureaucratic régime, with an embryonic General Staff, possessing almost no powers, termed the "Coördinating Board." Then, just as the A. E. F. was beginning field operations on a considerable scale, the General Staff was suddenly brought into existence and called upon to function intensively, with broad and penetrating powers. That results effected by this new order of things were unsatisfactory from many points of view seems only natural, especially from the points of view of line, departments and corps; but that the continuance of the old bureaucratic régime, with a toothless and clawless General Staff or Coördinating Board, would have secured better results, lacks convincing demonstration, to say the least. The departments and corps had fallen down seriously in many vital matters and were consuming valuable time and resources of talent in wrangling and struggling for advantage. Even the Corps of Engineers, which your correspondent rates as successful, was from start to finish torn by internal strife, in which the railroad policy formed a conspicuous storm center. Also, an intimate analysis of the performance of the Medical Corps, which your correspondent also classes as successful, would doubtless disclose much to criticise and correct. In fact, all departments and corps, as well as all branches of the line, developed many defects and weaknesses which must be eliminated in a great measure in order to secure in the Army establishment such efficiency as will enable it to stand the gaff of war work with odds not in its favor. The day may be much nearer than is generally realized when we shall have to take on single-handed something more than Mexico or Spain.

But the creation of a general staff with autocratic powers and a disposition to extend its participation beyond the general determination, control and coördination of the Army policy, and into the details of department corps and bureau administration and operation, seems like inserting a new train of gears into a machine to correct defective lubrication.

A general staff, with proper functions properly understood and properly performed, is doubtless essential to a high degree of military efficiency, but it must confine itself to its legitimate functions and must be so constituted as to render these functions effective. The general staff should contain as department heads and bureau chiefs the best talent in the service, and, by means of its capacity for understanding, determining and coördinating, rather than by its authority created by law, should command the respect, confidence and loyal coöperation of all branches of the service.

Thus far the General Staff appears to have created the impression of being a heavy burden added to those already imposed on the other branches of the service, with few compensating advantages, and its army of subordinates of being a pestiferous lot without definite or useful functions, and with a strong desire to justify their existence and aspirations for preferment by interfering with the affairs of other people already amply supplied with legitimate troubles.

This impression is doubtless due largely to inadequate understanding on both sides, which time, patience and experience alone can remove, but its removal will be undoubtedly seriously retarded by the creation of too much vested General Staff authority and extension of that authority too far and too intimately in parallel with the authority of the working forces of line, departments and corps.

In military work, as in all other work, there can properly be but one line of control. If "High Command" requires other lines of participation in the operations involved, these lines of participation must be definitely subordinate to the line of control. When the two clash, one or both must be changed. When "High Command" elects to operate unduly through a subordinate line of participation something is probably wrong with "High Command," chiefly in that it has failed to organize its line of control effectively and is trying to correct this failure by irritating and disorganizing methods.

The basic trouble with the functioning of the General Staff is exactly the same as that with the functioning of all other branches of the service—inordinate ego. The paramount object of creating an effective organization in time of peace, or of winning the war when war is on, is too often subordinated to personal, clique or class ambition, and struggle for advantage and promotion. It is notorious that the Army establishment during peace is a hot-bed of intrigue and strife for promotion, with scant regard for the good of the service or for personal ethics. In time of war this condition is greatly aggravated by intensified ambition and is not abated by patriotism, as some have fatuously thought.

To abate the malign influence of this condition, to compel constant loyalty to the paramount object, to encourage initiative and sense of personal responsibility, to develop and use the efficient and eliminate the inefficient, to exercise intelligence, discrimination and fairness in selecting, promoting and distributing personnel—all these considerations seem more important than the technical composition of the General Staff established by Congress.

The case demands a better psychology rather than a better system of organization. When the better psychology is obtained a better working system will follow automatically, rather than by legislation. If the better psychology is not obtained, no system will check the degeneration of both our military efficiency and of our patriotism. "Ex."

Book Reviews and the Post Office

Sir—I have just read your editorial on "Book Prices Barred by Postoffice." We have stood so much from the Postoffice Department the past year or two that this particular bit of inanity is simply in line with much else. But it goes rather too far. It is a serious inconvenience, in addition to being senseless.

Who is the particular fool who did it? Some individual must have made the ruling. Find out and ask him, publicly, Why? Placing personal responsibility is the best cure for such idiocy. Go to it!

Baltimore, Md. C. J. TILDEN.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Large Concrete Pipe Grouted at Special Joints

WELL holes were not provided for in the excavation estimates of a 48-in. reinforced-concrete bell-and-spigot storm-water drain on Fourth Ave., Salt Lake City, Utah. When the superintendent of construction found that there had been allowed only 1½ in. beyond the overall horizontal diameter of the bells, he devised a scheme whereby the joints could be grouted in much the same way that a lead joint is poured, but without the necessity of working around the bell after the pipe was pushed home. The end of the spigot is cast with a ring, set in the bottom of the form so as to make an annular space between the bell and the spigot 1½ in. wide, 1½ in. deep at the end of the spigot and 1¼ in. at the other end. The chamfer allowed the pipe to be pulled from the form without chipping. Access to the annular ring for pouring is provided by casting a rectangular opening 2 x 12 in. through the bell. The pipe is laid with this hole on top.

To hold in the grout during pouring, a ring of jute of the cheapest quality is placed around the pipe near the spigot end before it is entered into the bell. It is then rammed home with a long stick, and earth is backfilled against it. On the inside of the pipe oakum is packed into the opening, and a strip of 18-gage sheet steel is braced against the oakum. More oakum is used than enough to fill the joint, to take up the inequalities of the abutting pipes. By inserting a wire into the annular ring, the foreman can readily agitate the grout should anything create a stoppage or should the grout become air-bound. He notes such an occurrence by counting the number of buckets of grout poured, three buckets usually being required.

After setting a short time, the steel band on the inside is removed three or four joints back, the oakum is pulled out, and the joint is pointed up. Backfilling of the whole trench takes place within 48 to 72 hours after the pouring, but it can take place the same day if desired.

The whole procedure is carried on rapidly with a gang of five men and a foreman, a four-legged gantry or tower on rollers straddling the trench facilitating greatly the lowering operation and the entering of the spigot into the bell. The gantry is 12 ft. high, with 6 x 6 in. corner posts and a headframe from which a steel pulley block supports a five-part line. A hand winch operates the line, and the whole frame is rolled along on a plank track in the setting of the pipe. The rollers are 5 in. in diameter and 18 in. long and are set in bearings. Three men can move the gantry unless it is carrying a pipe, in which case bars are used at the rollers. The material is coarse gravel well packed with enough clay to make it stand vertical. In parts of the trench a volcanic ash is encountered at the bottom; this stands up well for a few feet in depth unless wetted. Speed in getting the joints placed quickly in these places is a factor. Ordinarily the above crew can lay eight pipes per day.

This work is under the general supervision of S. Q. Cannon, city engineer, with W. A. Alexander, construction engineer, directly in charge. The contractors are Shepard & Weber, to whom the pipe is furnished by the C. F. Massey Co., Chicago.

Other Articles in This Issue of Interest to Contractors:

Concrete Wall Construction Is Continuous Process — Page 454

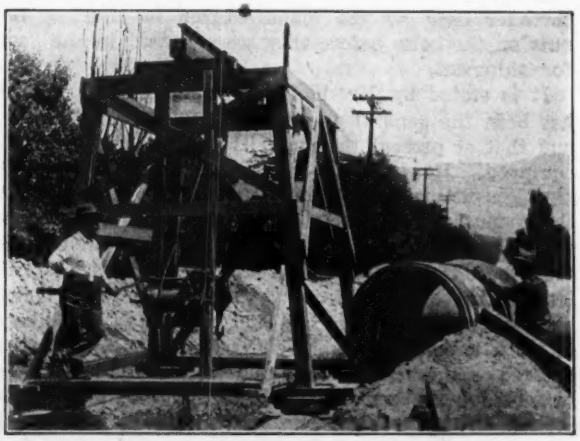
Large Train-Shed Raised Without Interruption of Traffic — Page 460

Corrugated Spacer Used for Wood-Block Pavements — Page 463

Move 200-Ton Transfer Bridge on Pontoons in New York Harbor — Page 478

Specify Kind of Bidders, Says Engineer (Letter) — Page 480

CONCRETE PIPE CAST WITH ANNULAR RING FOR GROUTING JOINTS



GANTRY TOWER ON ROLLERS FOR LAYING PIPE

Tight Nuts on Construction Bolts

EXPERIMENTS with loose nuts and tight nuts on bolts having a short threaded length have been made under the direction of H. E. Weightman, chief engineer of the Engineering Service Co., Chicago, who reports that the tests indicate a decided advantage for bolts having the tight-fitting nuts. Bolts of this kind are used extensively on electric-line work and also on construction work for guy clamps and anchors and for bonding reinforcement bars.

Field or service trials extended over a period of three years. Clamps with three and four bolts, some with finger-fit nuts and others with tight-fit nuts, were placed on pole lines of electric companies in different parts of the country. Records were kept of each clamp; they showed that nuts which could be run down by hand (or had a finger-fit) would work loose much more readily than the tight nuts (those requiring a wrench to turn them). Speed tests showed that a lineman could place as many clamps with tight-nut bolts as with loose-nut bolts; the time consumed in turning down the nuts is only a small portion of that required to assemble the anchor, guy and clamps. Tensile tests for shear on the threads were made on the bolts and nuts and gave results demonstrating that bolts with tight-fitting nuts have appreciably greater resistance to stripping of the thread then those with loose-fitting nuts.

For a vibration test, kegs of bolts with tight and loose nuts were placed in a small cart arranged with a motor drive to represent a delivery wagon traveling over rough roads. After it ran 200 hours, which is about the maximum service trip, it was found that nearly 30% of the loose nuts had worked off the bolts, even though they had been run down the full length of the 1½-in. threaded portion. Of the tight nuts only 1% were loose, although these nuts had been run down only the depth of the nut, with one additional turn to make them tight. These nuts were applied by a friction threader used by the manufacturer in running the nuts on the bolts before they were packed in the kegs for shipment.

It is stated by Mr. Weightman that in the past it has been the general practice to use loose-fitting nuts, and that at present the majority of the bolts are thus equipped. However, several manufacturers now supply tight-fitting nuts. The same prices are quoted, as the manufacturers explain that the only expense involved is that of adjusting the machine for the change from loose to tight fit. With less play or slack there is less chance of the thread of the nut or bolt being stripped when under stress, and the nut is less likely to work loose under vibration. The tight nut can be entered on the bolt with the fingers, and the use of the wrench for the remainder of the distance is not objectionable, because the threaded length to be covered is relatively short and the time required for bringing the nut to bearing is negligible, especially since a wrench must be used in any event for the final tightening of the nut.

As a result of the tests and service trials, Mr. Weightman's specifications now include the following provision: "When the face of the nut is flush with the end of the bolt the fit shall be neither so loose that any play or rocking between the nut and the thread of the bolt can be felt, nor so tight that the nut cannot be turned off with the fingers or run down the remaining length of the threads with a 6-in. wrench."

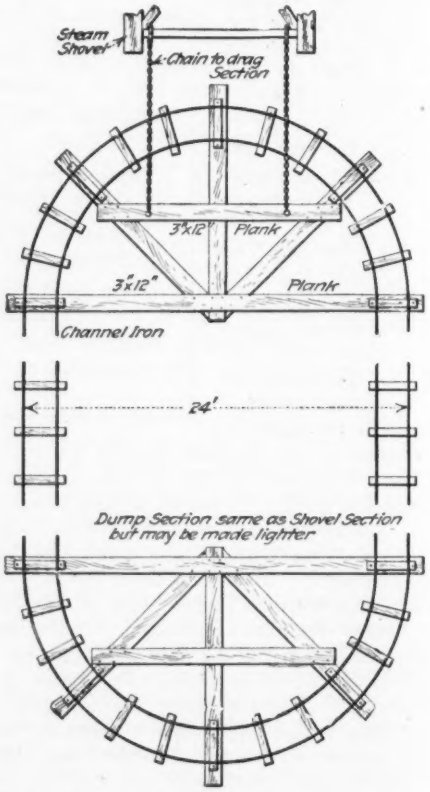
Endless-Track Arrangement for Carrying Away at Steam Shovels

By D. J. McFadden

New Jersey State Highway Department, West Portal, N. J.

AN ENDLESS, switchless track arrangement is being used by the New Jersey State Highway Department, which has two steam shovels at work in building a state road with convict labor near West Portal, N. J. The advantage of the arrangement is that the dump cars are always in gage with the steam shovel, and there is no useless track or useless travel of cars. In this work it is aimed to have the fill always up to grade as it is extended.

As shown in the accompanying illustration, the track arrangement consists in having two semicircular sec-



ARRANGEMENT OF ENDLESS, SWITCHLESS TRACK

tions, one of which is chained to the rear of the steam shovel while the other is at the end of the fill. As the steam shovel moves up and the fill extends, the intervening track is lengthened, the growing space being bridged by the use of channel irons placed upon the top of the rail ends to carry the dump-car wheels across until a new rail-length can be inserted.

On the work described, 24-in.-gage track was used in 15-in. lengths, and the channel irons were made 20 ft. long. The forward semicircle is drawn as the steam shovel moves ahead. The semicircle at the fill end is easily moved by three men. It is made of somewhat lighter construction, not being so thoroughly braced. In setting up the tracks, slight allowance has to be made at the joints between the semicircle and the track, to provide for the extra clearance required by the channel irons which fit over the ball of the rail.

NEWS OF THE WEEK

New York, September 4, 1919

Contractors Form Insurance Company

As a medium of cost reduction to contractors in bonding and compensation insurance, the Contractors' Service Corporation has been organized as a subsidiary of the Associated General Contractors of America. This special-service feature will be operated by B. Clinton Mackey, Luther E. Mackall and a prominent liability underwriter.

In order to insure the proper functioning of this new organization, Daniel A. Garber, president of the Associated General Contractors of America, calls upon its 400 members to make use of this new service feature. "If this be done," asserts Mr. Garber, "the volume of business will be such as to give the managers of the corporation a very large influence in fixing rates and in obtaining proper coverage and prompt service."

For the convenience of the members of the Associated General Contractors of America, agencies of the Contractors' Service Corporation will be established in the principal cities.

Engineers Will Tender Banquet to Hoover

Arrangements are being made, under the auspices of the American Institute of Mining and Metallurgical Engineers, for a banquet to be held in New York City in honor of Herbert C. Hoover shortly after his arrival, which is expected some time in the middle or latter part of this month. The officers of the general committee are W. L. Saunders, 11 Broadway, New York City, chairman; Charles F. Rand and E. P. Mathewson, vice-chairmen.

Lumber Order for French Contract Being Placed

All lumber that will go into the construction of the 2000 frame dwellings which MacArthur Bros. recently contracted to erect for the French Government will be shipped from Jacksonville, Fla.

Ten million feet, board measure, will be required. Orders for materials are now being placed, and shipment will begin in about two months. The dwellings will be one-story, three-room structures. They will probably be erected by French labor under American supervision.

Striking Western Trainmen Heed Hines Ultimatum

Striking enginemen and trainmen in California, Nevada and Arizona who had, last week, temporarily tied up transportation in the districts affected, returned to work after an order had been issued by Director General of Railroads Hines which stated that all men on strike would be dropped from the rolls if they did not return to work by Aug. 30. The strike was in sympathy with the striking employees of the Pacific Electric Railway Co., the lines of which are privately operated.

Officers of the American Federation of Labor have also acquiesced in President Wilson's request that 90 days elapse before action be taken by the railroad shopmen. The President indicated that strikes only aggravated already serious living conditions and that through avoiding strikes greater opportunities for the reduction of living costs were possible.

Employment Bureaus

Engineering Societies' Employment Bureau of the four founder societies, conducted by Engineering Council Employment service, for members and for other professional men introduced by members. Especial attention for those released from Government service. Address, 29 W. 39th St., New York City.

American Association of Engineers, 29 S. La Salle St., Chicago. Service to members only, but Army or Navy Engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

Professional and Special Section, United States Employment Service, 469 Fifth Ave., New York City.

Reëmployment Committee of New York City for Soldiers, Sailors and Marines, 505 Pearl St.

Form New York State Highway Council

The New York State Council of the Federal Highway Council was recently organized in New York City, with the following officers:

Chairman, Arthur H. Blanchard, president of the American Road Builders' Association and president of the National Highway Traffic Association; vice-chairmen, Frederick S. Greene, New York commissioner of highways; Lieut.-Col. Theodore Roosevelt; E. J. Mehren, editor of *Engineering News-Record;* George M. Graham and D. C. Fenner; Secretary-Treasurer, H. W. Perry, manager of the Trailer Manufacturers' Association of America.

Would Return Roads Under Rigid Control

Bill Before Senate Provides for Division Into Regional Systems Privately Owned

Under a bill offered in the Senate, Sept. 2, by Senator Cummins of the Interstate Commerce Committee, the railroads would be returned to private ownership, but divided into 20 to 35 operating units, or regions, under a rigid system of Federal control to be exercised by a new Railway Transportation Board and by the Interstate Commerce Commission, which would retain the power of reviewing rates. It is expected that the program outlined in the measure may have the support of the majority of the Senate, notwithstanding the fact that the Esch bill, already introduced in the House of Representatives, provides for the return of the railways to their owners without the restrictions of the present Cummins bill.

The Railway Transportation Board, created under the bill, consists of five members, appointed by the President, to be approved by the Senate, at $12,000 a year. None of these officials may be associated in any capacity with a railroad.

The Interstate Commerce Commission is to exercise general jurisdiction over the formation of the new railroad plan and is to maintain the supervisory power it now has over rates.

Under one provision of the bill railroad employees would share in any excess of profits accrued under the new method. The proportion of profits to be thus distributed is to be based upon a "fair return upon the value" of the railroad property. This would be determined by the Railway Transportation Board.

One-half of the excess profits would be applied under this scheme, first, in improving the conditions of work of railroad men, and after that there would be a direct share in the excess return. The other half of the excess profits would be placed in a fund for the use of the railroad board in the purchase of equipment, or for lending it to individual railroads for that purpose.

Wage questions would be decided by a joint committee comprising railroad workers and owners. One provision of the bill stipulates against strikes or lockouts.

The issue of railroad stocks and bonds is regulated under the measure, being put under the control of the Interstate Commerce Commission. Governmental approval of new lines or extensions and of all bonds relating to them would be required.

Railroad Security Owners Ask Guaranteed Returns

The presentation to Congress of a memorial from the railroad security owners of the country, petitioning for a railroad settlement that will guarantee a fixed return on investments, by S. Davies Warfield, president of the National Association of Owners of Railroad Securities, was a feature of the proceedings during the past week before the committee on interstate and foreign commerce of the House of Representatives.

The memorial was issued over the signatures of various banks and insurance companies throughout the country. It states that the real question at issue is the fixed-percentage return provided in the Warfield plan and that all the rest becomes mere machinery. The memorial draws the comparison between the present Federal reserve act and the legislation which it urges in the form of the Warfield plan of the National Association of Owners of Railroad Securities. It is emphasized that the keystone of the situation is the ratemaking power.

The memorial states that it is issued "by or on behalf of the 50,000,000 American citizens owning or directly interested in railroad securities—including over 9,000,000 savings depositors, 33,000,000 insurance policyholders and millions of others whose investments in national and state banks largely represent railroad securities—trust estates and individual investors."

Gompers, Home From Europe, Is Silent on Plumb Plan

Although asked repeatedly for a statement of opinion upon the Plumb plan for railroad nationalization, Samuel Gompers, president of the American Federation of Labor, upon his return from Europe, where he went to serve American labor interests at the Amsterdam session of the International Trades Union Congress, replied, "I reserve the right to refuse to answer to that question."

Mr. Gompers did discuss freely European conditions and the war's possible effects on labor. He asserted that "whoever has not learned that autocracy or kaiserism, whether it be military, political, commercial or industrial, is a dead issue, has not learned the real lesson of the war."

As a corollary, Mr. Gompers, in addressing a meeting of the striking actors of the Actors' Equity Association, asserted that "all men and women in the professions who work for salaries or wages have the right, the unqualified right, to sit in the councils which determine their pay and the conditions under which they work."

Discussing political and social conditions on the European continent, Mr. Gompers said: "Bolshevism, I learned, is on the wane. It has failed in its hopes and aims, and the people who looked to it for political, economic and social salvation find that they have no peace, no bread, and no work. This will precipitate the downfall of Bolshevism."

Daniels Dedicates Naval Dry Dock

The naval dry dock at Pearl Harbor, H. I., was dedicated Aug. 21 by Secretary of the Navy Daniels. Mrs. Daniels acted as sponsor, pressing the electric button that flooded the structure. The dry dock was completed several months ago, it being unwatered for the first time Apr. 11, 1919. Peculiarities in its design and construction were described in *Engineering News-Record* of July 25, 1918, p. 173. The dry dock has a clearwater basin 1010 ft. long and 101 ft. wide at the bottom clearance. The distance from the top of coping to the floor is 43½ ft.

A. A. E. Chapter Joins New York Engineers in Pay Demand

The New York Chapter of the American Association of Engineers has approved a report from its public service committee recommending the flat increase of $500 per year in the pay of technical engineers employed in the various city departments of New York City and by the Public Service Commission and transit construction commissions, which increase was previously requested in a letter from the New York Union of Technical Men, Local No. 16,388, American Federation of Labor, addressed to all city and rapid transit officials of New York City, including the borough presidents.

As yet no definite settlement has been reached nor have definite replies been received by the New York Union of Technical Men to its request for a flat $500 increase. This is presumed to have been due to the fact that a number of officials have been away on vacation.

A short time ago the union issued a statement purporting to indicate that the average salary of the New York City technical man was less than the minimum salary paid in San Francisco.

Wheeling Begins Civic Development

Civic development, demanded by the need for increased housing areas, has been started in Wheeling, W. Va. Maurice Scharff, of the engineering firm of Morris Knowles, Inc., Pittsburgh, Penn., has opened offices in Wheeling, and surveys have been started on three possible schemes of development. These three schemes are the extension of Chapline St. so as to connect with the National Pike at Fulton; the reclamation of the Wheeling Creek area; and making accessible the Chapline Hill.

The project is financed by the Wheeling Improvement Association, an organization of representative business men.

Motor-Truck Lines Planned for Rural New York

To coöperate in the establishment of motor-truck express lines in those rural sections of New York State where farmers are having most difficulty in getting their perishable products to market quickly, is one of the functions of a commission recently appointed by Governor Smith. The chairman is former Representative Peter G. Ten Eyck, and other members are Frederick S. Greene, state commissioner of highways; Professor Boyle of the State College of Agriculture; William E. Dana, chairman of the Council of Farms and Markets, and F. W. Fenn of the National Automobile Chamber of Commerce. The committee will work, through farmers' organizations and municipal officials, to encourage the opening of truck routes. No state appropriation will be asked at present.

It has been found that in many cases farmers are unable to get their goods to New York markets as quickly as are shippers from Florida who have the benefit of direct express service. Farmers with small shipments for short hauls have often found their goods delayed. The commission estimated that 50% of the perishable produce grown in the state does not get to market.

In favor of the motor express lines it was stated that the delivery of food by this means could be accomplished at three-fifths the cost of railroad delivery and at a gain in speed.

Criticizes Canadian Salary Ratings

In a letter, Aug. 27, to Alfred D. Flinn, secretary of Engineering Council, Arthur S. Tuttle, chairman of that body's committee on classification and compensation of engineers, objects to the proposed "Classification of the Civil Service of Canada," as recommended recently by Arthur Young & Co. The same firm, it is understood, is performing a similar service for the United States Congressional committee on reclassification and compensation of Government employees, including engineers.

"In general," Mr. Tuttle points out, "promotion through most of the [Canadian] grades is by increments of about $120, the minimum and maximum rates of each being respectively higher and lower than the rates fixed for the grades below and above, this resulting in a comparatively small salary range for each position and in this respect corresponding with what seems to have been the general practice heretofore. This treatment is one which it would seem desirable to modify, to the end that the relative ability and experience of men performing similar work may be given adequate recognition."

Exceptions are noted in the case of "topographical engineer," where a salary range from $2160 to $3120 is pro-

posed, and in the case of promotion from "junior electrical engineer," at a maximum salary of $1980, to "electrical engineer," with a minimum salary of $2640, each of the two latter grades having an extreme salary range of only $360. In the case of "chief draftsman," "structural engineer," and "chief topographical engineer," maximum salaries are proposed of $3000, $3240, and $3840, with no provision for promotion to other engineering grades, although for each position the qualifications required are such as to indicate ability to progress to high positions in the service. A table also shows that only six engineering positions are open to compensation at a rate of more than $6000 per annum.

"It would seem," says Mr. Tuttle, "that this report is open to serious criticism on the grounds that it fails to group engineering service along orderly lines, that it provides too narrow limits for promotions within a grade, and that the compensation proposed for all grades is inadequate for the service rendered. The latter criticism seems particularly pertinent in comparison with the rates now being demanded by organized labor. The practicability of properly meeting present-day conditions by the addition of a 'special war bonus' to the proposed rates, in order to meet the present high cost of living, is also to be questioned on the ground that, and as set forth in the circular letter issued by the council's committee on classification and compensation of state and municipal engineers, the 'revolutionary change in the cost of living' is one which "unless modified by further economic disturbance is likely to be permanent or to continue for a long time to come.'"

Joint Meeting Planned for Road Discussion

As the county commissioners of the State of Washington and those of the State of Oregon are to hold their annual convention during the same days, Sept. 11-13, inclusive, arrangements have been made to hold a joint meeting of the two state bodies to discuss coöperation in state highway building, as well as other matters of mutual interest. The Washington commissioners will hold their convention in Vancouver. Portland will be the meeting place of the Oregon commissioners.

New Quarters for American Association of Engineers

Within the next two or three weeks, it is announced, the national headquarters of the American Association of Engineers will be moved from its present location at 29 S. La Salle St., Chicago, to the Nepeenauk Bldg., 63 E. Adams St., where lease has been taken for 6000 sq.ft. of office space. The Chicago chapter, which now has over 1100 members, will take over the space vacated by the national headquarters of the association.

Asphalt Association Investigates College Highway Courses

In order properly to equip technical school graduates for the administrative, executive, business and engineering positions in national, state, county, town and municipal highway departments of the United States and in the Dominion, provincial and municipal departments of Canada, the engineers of the Asphalt Association have planned and are developing a rather comprehensive educational campaign.

Preliminary investigations show that but 25 of 93 colleges examined are giving satisfactory fundamental training in highway engineering as a part of the civil engineering course. This statement comes from Arthur H. Blanchard, professor of highway engineering, University of Michigan, who is associated with the engineers of the Asphalt Association in the development of their educational plan.

That the enormous size of the highway building schedule, indicated by the 1919 appropriation of $500,000,000 in the United States and a relatively large amount in Canada, demands technically efficient and businesslike engineers to direct the expenditure of this vast sum, is the stand taken by the association's engineers. Consensus of opinion among highway engineers and educators indicates that highway engineers should have the broad technical training which the four-year course in civil engineering gives. It is the contention of such engineers that the annual waste of millions of dollars in the United States in highway construction will not cease until the profession of highway engineering is placed on an equal basis with structural, hydraulic, sanitary and other branches of civil engineering.

This plan of the Asphalt Association contemplates coöperation with colleges and universities throughout the United States and Canada, whereby increased attention will be given to courses of instruction in highway engineering.

Treatment of Stockyards Waste in Chicago

That the cost of treatment of trade wastes from the Chicago stockyards at an activated-sludge plant to be built by the Sanitary District of Chicago may be assessed with reason upon the packing companies, is the conclusion of a joint report, dated Aug. 19, 1919, made to the Sanitary District by committees of the Chicago City Club, the Woman's City Club, the Chicago Woman's Club and the 29th ward. The district proposes to assume 15% of the operating expense. The packers have claimed that to assess the balance against them would be unfair but have offered to pay 40%, not as an obligation but as a concession in the interest of arriving at a settlement.

Public policy in such cases in the future should recognize waste disposal as an element in cost production, according to the report. Taxation by the district has been proposed in the present case, but this would place an additional burden upon other plants which produce little or no trade waste for disposal by the Drainage Canal, and the estimated operating cost of $825,000 would increase the tax rate of the district by nearly 20%. It has been asserted frequently that the packers pay 16% of the taxes raised by the district, but the report points out that the correct figure is about 3%, the higher figure being based probably upon a statement that 16% of their taxes is paid to the district. On the other hand, they contribute from 16 to 25% of the sewage to be treated. The conclusion arrived at is that the Sanitary District would be justified in charging the packers with the entire cost of disposing of their trade wastes, and in extending the same policy to other industries. The offer of 40% is considered inadequate, especially when made as a gratuity.

In a report made by representatives of the Sanitary District and the packers in 1917 (see *Engineering News-Record* of June 21, 1917, p. 594) it was recommended that a single unit of the proposed plant should be built at first as an experiment. The present report, however, points to the wide development and use of the activated-sludge process since that time, and urges that under the 1917 plan, with time allowance for a test of the first unit, a plant of sufficient capacity to care for all of the stockyards wastes could not be completed for several years. It is urged that such a delay in ending the present objectionable situation would be unfortunate.

Colonel Wilgus Made Officer of Legion of Honor

Col. William J. Wilgus, of New York, who was deputy director-general of railways in the American Expeditionary Forces in France, and received the Distinguished Service Medal from the United States, has been made an Officer of the Legion of Honor by the French Government in recognition of his services during the war.

Motor and Horse Traffic Separated on New York Bridges

Separation of horse and motor-vehicle traffic was put into effect on two of the East River bridges in New York City last week because of traffic congestion, which was specially troublesome during a street-car strike in Brooklyn some weeks ago. The Brooklyn Bridge roadway is henceforth a highway for horse-drawn vehicles only, and the Manhattan Bridge a highway for motor vehicles only. The intent is to separate slow traffic from fast traffic and thereby avoid interference and increase the capacity of both bridges.

This order is the first result achieved by a committee of city officials which

has been appointed by the Mayor to study traffic conditions on the bridges and devise means of improving them and, if possible, increasing the traffic capacity. Edward A. Byrne, of the city's Department of Plant and Structures, is secretary of this committee. One of the facts which this committee faced at the outset was a remarkably heavy and constantly growing vehicle traffic, most serious on the two southerly bridges, which lead to the business center of Brooklyn. During the strike already referred to, the traffic grew to excessive density, and the amount of the traffic, in conjunction with interference between fast and slow vehicles, produced intolerable congestion. The committee was appointed immediately after the strike, and its work is likely to continue for some time to come.

Endowment Fund Drive On For M. I. T.

To meet the increased cost of instruction, and to balance the loss of financial support from the State of Massachusetts, withdrawn because of a clause in the new constitution, a nation-wide drive for $10,000,000 has been started by the endowment fund committee of the Massachusetts Institute of Technology. The committee is headed by H. Coleman du Pont, and its headquarters are at his offices, 120 Broadway. The other members of the committee are Theodore N. Vail, Charles A. Stone, Otto H. Kahn, and Charles Hayden, of New York; Everett Morse of Boston, Edmund Hayes of Buffalo, and Dr. Richard C. MacLaurin, president of the institute.

Contributions will be received by Mr. du Pont or by Mr. Stone at the offices of the committee. It is expected that the drive will close Jan. 1, 1920.

New York Association of Architects Admits Draftsmen

Draftsmen, as well as registered architects, are eligible to membership in the New York State Association of Architects, according to the terms of a new constitution, recently made public. Draftsmen must be over 21 years of age and employed in the office of an architect elegible to membership in the association. Such draftsmen may become junior members. The only privilege of membership denied junior members is the vote at meetings of the association.

Commenting upon this clause in the constitution, the *Bulletin* of the association, in its first issue, recently published, says: "If architecture is to take its rightful place in the upbuilding of the new world, there must be joined in one effort all those who are engaged in architectural work—whether as employers or employees, beginners or experts. The whole group of architects and those who are to be the architects of the future must move forward together."

To Discuss Sanitary Engineering at Public Health Meeting

Water-supply and sewage disposal are the principal topics which will be discussed at the meeting of the sanitary engineering section of the American Public Health Association, to be held in connection with the annual meeting of the association in New Orleans Oct. 27-30. The reports of the committees on water-supply and sewage will be presented before the section.

Other reports to be made at the meeting of the engineering section are those of the following committees: On sanitary control of waterways, Harrison P. Eddy, chairman; on water-works operation and analytical methods, Edward Mayo Tolman, chairman; on sewage-works operation and analytical methods, C. B. Hoover, chairman; on refuse collection and disposal, E. D. Rich, chairman; on milk pasteurization, H. A. Whittaker, chairman. C. G. Earl and Kenneth Allen are chairmen of the committees on water-supply and sewage disposal, respectively.

The tentative list of papers to be delivered before the section includes the following: "Water Supply and Typhoid Fever," by Col. George A. Johnson; "Operating Features of the St. Louis Water-Works," by E. E. Wall; "Control of Water-Purification Plants in Ohio," by W. H. Dittoe; "Typhoid Fever Outbreak in Charleston, W. Va.," by Edward Mayo Tolman, and "The Engineer in Public Health Work," by Morris Knowles and Maurice Scharff. It is also expected that papers will be presented by Thorndike Saville, Frederick Bass and Charles Saville.

Indiana Spending $5,000,000 on Roads

About 80 miles of road are now under contract by the new Indiana State Highway Commission, the work being scattered over the state and consisting of sections from 5 to 12 miles in length. Bids on approximately 58 miles of highway will be opened early in September. All of the work let so far is for cement concrete, except two sections of bituminous concrete. It is the policy of the commission to reconstruct as soon as possible the worst stretches of road in the state highway system, as in this way the cost of maintenance can be reduced considerably and the system can be kept in better condition.

With the letting of work in September, practically 130 miles of highway will be under contract, and the total amount of these contracts will be about $5,000,000. It is intended to let between 300 and 400 miles additional between September, 1919, and March, 1920, the main portion of this being let, probably, after Jan. 1, 1920.

Survey parties are now in the field, and office forces are busy in the preparation of plans and specifications for this work. In addition, a considerable number of bridges, of more than 20-ft. span, are to be advertised during the latter part of this year or early in 1920. All of this road and bridge work is under the direction of H. K. Bishop, chief engineer of the Indiana State Highway Commission, Indianapolis.

Civil Service Examinations

New York State. Bridge designer, office of Transit Construction Commissioner, $1500 to $2100, Sept. 27. Apply to Civil Service Commission at Albany for application forms, before Sept. 15.

New York State. Junior assistant engineer, State Engineer and Highway Department, $1200 to $1440, Sept. 27. Apply to Civil Service Commission at Albany for application forms, before Sept. 15.

New York State. Junior engineer, Transit Construction Commission, New York City, $1200 to $1500, Sept. 27. Apply to Civil Service Commission at Albany for application forms, before Sept. 15.

New York State. Sanitary engineering inspector, State Department of Health, $1320, Sept. 27. Apply to Civil Service Commission at Albany for application forms, before Sept. 15.

United States

For United States civil service examinations, listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

Specification engineer, Office of Chief Signal Officer, War Department, Washington, D. C., $2000 to $2400 per year, Sept. 9. File applications before Sept. 9.

Chief metallurgist, $4,500 to $5,000 per year; assistant chief metallurgist, $3,600 to $4,500 per year, Ordnance Department. Applications must be filed before Sept. 16.

Computer, Ordnance, Navy Yard, Washington, D. C., $7.20 to $12 per diem, Sept. 17. File applications in time to arrange for examination at place selected by applicant.

Junior highway bridge engineer, Office of Public Roads and Rural Engineering, Department of Agriculture, $1200 to $1600 per year, Sept. 17. File applications with commission at Washington in time to arrange for examination at place selected by applicant.

Assistant examiner, Patent Office, Washington, D. C., $1500 to $1740 per year, Sept. 17 to 19 and Nov. 19 to 21. File applications in time to arrange for examination at place selected by applicant.

Engineer, $3000 per year; assistant engineer, $1800 to $2880 per year; junior engineer, $1200 to $1740 per year; engineering draftsman, $1200 to $3000 per year, Reclamation Service. Applications will be received until further notice.

ENGINEERING SOCIETIES

Calendar

Annual Meeting

NEW ENGLAND WATER WORKS ASSOCIATION; Tremont Temple, Boston, Sept. 30, Oct. 1-3, Albany, N. Y.

AMERICAN SOCIETY OF NAVAL ENGINEERS: Secretary, Lieut. Com. F. W. Sterling, U.S.N., Navy Department, Washington, D. C.; Oct. 7, Washington.

AMERICAN PUBLIC HEALTH ASSOCIATION: 169 Massachusetts Ave., Boston; Oct. 27-30, New Orleans.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS; 304 E. Walnut St., Bloomington, Ill.; Nov. 11-14, New Orleans.

The San Francisco Association of Members of the American Society of Civil Engineers, at a meeting Aug. 19, voted to favor the national Department of Public Works and indorsed the formation of a California Council of Engineers. A paper on the development of San Francisco harbor was presented by Frank G. White, chief engineer, Board of State Harbor Commissioners.

The Engineers' Club of San Francisco, Aug. 21, listened to a luncheon talk by John R. Freeman, who was passing through San Francisco on his way to China to "modernize the Grand Canal." The talk was under the auspices of the local section of the American Society of Mechanical Engineers. On Aug. 26, F. H. Newell spoke before the club on the subject, "The Engineer in Modern Life; His Needs and Ideals." This meeting was under the auspices of the local chapter of the American Association of Engineers.

The Detroit Engineering Society will hold the opening meeting of the season Sept. 5. Maj. Edwin Denby, U. S. M. C., and several members who have been overseas, will address the meeting. A report from the committee on the housing problem will be presented.

The Toledo Chapter of the American Association of Engineers was formally installed Aug. 26 by Maj. Garrison Babcock, U. S. A., past president of the association.

PERSONAL NOTES

CAPT. LUCIUS A. FRITZE, Sanitary Corps, U. S. A., has become associated with the technical staff of Wallace & Tiernan Co., Inc., New York City, manufacturers of chlorine control apparatus. Captain Fritze, who was sanitary officer of the Rainbow Division, after the armistice was assigned to the Office of the Surgeon General in Washington and while there prepared a history of the Sanitary Corps of the A. E. F. Captain Fritze will be manager of a new office which Wallace & Tiernan Co. are opening in Kansas City, Mo., serving territory comprised in the states of Montana, Wyoming, Colorado, North Dakota, South Dakota, Nebraska, Kansas and Missouri.

G. A. CARROLL has returned from military service and has been appointed division engineer, Chicago, Rock Island & Pacific Ry., with headquarters at Eldon, Mo. Mr. Carroll was previously division engineer of the El Paso division.

LIEUT. COL. FRANK B. MALTBY, Engineers, U. S. A., has received his discharge and will be a member of the advisory committee to the War Claims Board, Washington, D. C. Lieutenant Colonel Maltby was section engineer of Base Section 1, with headquarters at St. Nazaire, France, and was decorated by the French Government with the cross of Chevalier of the Legion of Honor.

CAPT. HAROLD M. LEWIS, commanding Co. D, 502nd Engineers, recently returned from France after nineteen and a half months' foreign service and has received his discharge. Captain Lewis is a graduate of Williams College and Rensselaer Polytechnic Institute; before the war he was resident engineer for Charles W. Leavitt, landscape engineer, New York City, on the reconstruction of the estate of Charles M. Schwab at Loretto, Penn.; he has resumed his connection with the same organization.

GEORGE H. SHAW, formerly sanitary engineer of the division of shipyard sanitation, United States Public Health Service, has been appointed chief of the division of housing and sanitation in the Bureau of Health at Philadelphia, Penn.

SOL. PINCUS, associate sanitary engineer, United States Public Health Service, has been detailed to Little Rock, Ark., for the purpose of investigating the quality and state control of water-supplies in Arkansas and Oklahoma.

H. E. BILGER, road engineer, Division of Highways, State Department of Public Works, Illinois, has submitted his resignation, thereby terminating a service of 12 years. On Sept. 1 he became consulting engineer for the Monmouth Stone Co., Monmouth, Ill.

H. E. M. KENSIT, for two years with Canadian engineers in France and, after being wounded at Vimy Ridge, assigned to the Ministry of Munitions of War, England, has returned to the Dominion Water Power Branch, Ottawa, Ont.

GEORGE LAWRENCE SMITH, having completed his work on the Boston Army supply base, of which project he had charge, has returned to his private practice of architect, associated with FAY, SPOFFORD & THORNDYKE, consulting engineers, Boston.

C. S. OGILVIE, assistant engineer, Grand Trunk Ry., Ottawa, Ont., has been transferred to the Montreal division, with offices in Montreal.

R. B. JOHNSON, assistant engineer, Montana division, Oregon Short Line, has resigned to enter private practice at Idaho Falls, Idaho.

C. M. BAKER, associate sanitary engineer, United States Public Health Service, has become State Sanitary Engineer of Wisconsin, with headquarters at the offices of the State Board of Health, Madison.

T. C. FISCHER has resigned as office engineer, Central Railroad of New Jersey, with headquarters in New York City, to become corporate engineer at the same point.

MAJ. FRED PATSTONE, 217th Engineers, U. S. A., has received his discharge and has resumed his position as city engineer of Manila, P. I.

W. S. KINNEAR & CO., engineers, New York City, announce the opening of a branch office in Detroit, under the management of L. W. KINNEAR.

J. A. BROAD, Newberry, Mich., county engineer of Luce County, has been appointed by Governor Sleeper a member of the State Board of Examiners of Architects, Engineers and Surveyors.

R. B. REASONER, recently back from military duty overseas, has returned to his work as division engineer, Oregon Short Line, with headquarters at Pocatello, Idaho.

L. H. NISHKIAN, formerly consulting structural engineer, Board of Public Works, San Francisco, has opened offices in the Monadnock Bldg., San Francisco, to engage in the general practice of civil engineering.

A. H. HOULT has been appointed assistant engineer, Montana division, Oregon Short Line, succeeding R. B. JOHNSON, resigned to enter private practice, as noted elsewhere.

PROF. CHARLES M. STRAHAN, department of engineering, University of Georgia, has been appointed, by the Governor, chairman of the State Highway Commission.

I. O. GIBBLE has been appointed engineer in charge of the newly opened Detroit office of the United States Structural Company.

A. C. BRADLEY, recently released from military service, is to return to his duties as division engineer, Chicago, Rock Island & Pacific Ry., with headquarters at El Reno, Okla.

A. D. LUDLOW, engineer of sewers, Kansas City, Mo., recently tendered his resignation to the Board of Public Works, effective Sept. 1. Mr. Ludlow

completed the plans for the Turkey Creek sewer, contract for which was awarded Aug. 22 to Thomas Kelly & Sons, of Winnipeg, Canada, for $2,453,749.

ALBERT T. RHODES has been appointed district engineer of the Asphalt Association, with headquarters at Worcester, Mass.

CAPT. G. R. B. SYMONDS, Engineers, U. S. A., has been discharged from the service and has been appointed highway engineer, District 9, Bureau of Public Roads.

THE C. E. GRUNSKY CO., engineers, San Francisco, has been organized to take over the business of the American Engineering Corporation. C. E. GRUNSKY is manager of the new corporation.

E. B. HUNLEY, previously of the 545th Engineers, A. E. F., has resumed his duties as assistant engineer of the Idaho division, Oregon Short Line.

E. S. NEEDHAM, formerly corporal, 46th Co., 20th Engineers, has received his discharge in England and has opened an office in London as structural engineer.

LIEUT. FREDERICK WHEELER, Engineers, U. S. A., has received his discharge from the Army and is now holding the position of chief of party with the California Highway Commission.

MESSRS. KASTENHUBER AND ANDERSON, having been discharged from the Army, have reopened their office at Easton, Md., and will resume the practice of engineering and surveying.

T. L. PIDOCK, recently released from military service, has returned to his work as chief draftsman, maintenance-of-way department, Oregon Short Line, with headquarters at Pocatello, Idaho.

OBITUARY

THOMAS MCNALLY, president of the Monongahela Construction Co., and of Thomas McNally & Son Co., died at his home in Pittsburgh, Penn., Aug. 24. He was born in Pittsburgh, Oct. 8, 1858. He began work as a newsboy in 1864; continued until 1870, when he began steamboating from Pittsburgh to New Orleans, working as cabin boy, deck hand and lamp trimmer, until 1877, when he quit the river and went to work as a laborer on the construction of the Pittsburgh & Lake Erie R.R., shortly afterward being made foreman of the piledriving and trestle gang. He went into the subcontracting business in 1881 and constructed the present B. & O. R. R. trestle from Federal St. to Woods Run. In 1883 he went with Booth & Flinn on general contracting, and on leaving them in 1889 began business for himself. He executed some large contracts.

CHARLES T. CHURCH, former city engineer of Geneva, N. Y., died Aug. 25. He was 85 years old and he was born in Churchville, N. Y. He was a graduate of Union College, and a member of the American Society of Civil Engineers. He was city engineer of Geneva from 1902 to 1909 and superintendent of public works.

Chicago Exhibit to Show Advance in Chemical Industry

The advance made by this country in the chemical industry during the war will be shown at the fifth national exposition of chemical industries which will open in Chicago Sept. 22, in the Coliseum and the First Regiment Armory, during the week of the meetings of the American Institute of Mining and Metallurgical Engineers, the American Ceramic Society, the American Electrochemical Society, and the Technical Association of the Pulp and Paper Industry. As great a number of exhibitors as last year will be represented, as well as many who have never exhibited before.

Motion pictures, including a series furnished by the United States Bureau of Mines, will furnish a feature in the program and will show actual processes and industrial methods.

BUSINESS NOTES

THE PARKER MOTOR TRUCK CO., Milwaukee, Wis., has appointed C. C. Newburn as assistant sales manager.

THE MANSFIELD STEEL CORPORATION, Detroit, Mich., has promoted A. Brauer from body designer to assistant to the general manager, in charge of production.

THE NAZARETH FOUNDRY & MACHINE CO., Nazareth, Penn., has appointed George Taylor Clift as superintendent.

THE BATES & ROGERS CONSTRUCTION CO., Cleveland, Ohio, received Aug. 29 the contract for 16.7 miles of 18-ft. 4-in. reinforced-concrete state highway on the Akron-Cleveland road. The contract involves the sum of $826,000.

THE KING TRAILER CO., Ann Arbor, Mich., has opened a factory branch in Dallas, Tex., in charge of A. G. Williams, Southwestern sales manager.

THE W. F. KEARNS CO., Boston, which has recently completed the large Boston Army supply base, involving the expenditure of $28,000,000, has reorganized under the name of Kearns Construction Co., with practically the same officers. The firm has issued an elaborate booklet illustrating $40,000,000 worth of recent work; most of it is in the vicinity of Boston.

THE GREEN ENGINEERING CO., East Chicago, Ind., has appointed E. L. Sullivan representative in the Pittsburgh district, including western Pennsylvania, eastern Ohio and the western part of West Virginia.

TRADE PUBLICATIONS

The following companies have issued trade publications:

THE TRUSCON STEEL CO., Detroit, Mich.; handbook, 8½ x 11 in., 80 pages, illustrated; contains complete descriptions, plans and illustrations of steel window installations; also describes continuous steel sash and Truscon "operator."

THE FISHER GOVERNOR CO., Marshalltown, Iowa; booklet, 6 x 9 in., 24 pages, illustrated; describes various types of Fisher traps and installations in pumping and power plants.

THE PELTON WATER WHEEL CO., San Francisco and New York; bulletin No. 12, illustrated; describes water wheels and their installation.

THE WEBER CHIMNEY CO., Chicago, Ill.; pamphlet, 5 x 9 in., 56 pages, illustrated; presents descriptions, drawings, views and dimension lists of concrete chimneys.

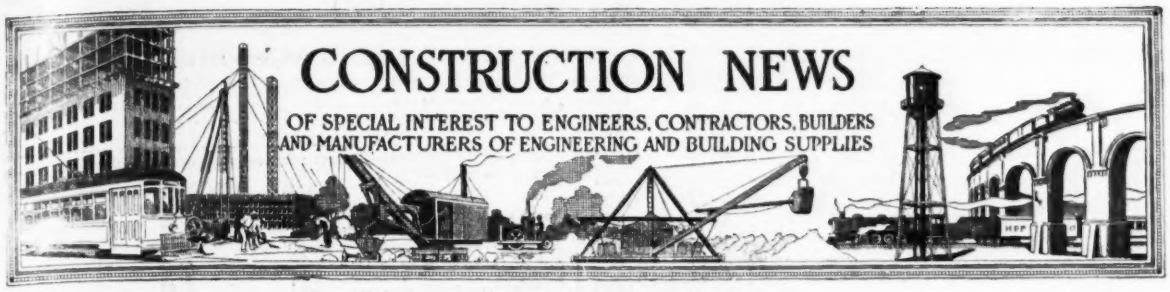
THE GEORGE HAISS MANUFACTURING CO., INC., New York City; booklet 719, 7 x 9¼ in., 15 pages, illustrated; tells of Haiss clamshell buckets for dredging and material handling and Haiss hoisting equipment.

THE NATIONAL PRESSED STEEL CO., Massillon, Ohio; "National Steel Lumber Handbook," for use in building construction; gives information on light-weight, fire-resisting systems of construction in steel lumber, with specifications.

THE WAGNER MANUFACTURING CO., Cedar Falls, Iowa; catalog No. 18, 7¾ x 10¾ in., 56 pages, illustrated; gives descriptions and price lists of overhead carrier system for factories, docks and warehouses; also trolley hangers for sliding and folding doors and sliding fire doors.

THE WELLMAN-SEAVER-MORGAN CO., Cleveland, Ohio; bulletin No. 27, 8½ x 11 in., 10 pages, illustrated; treats of Wellman-Seaver-Morgan automatic ore unloaders as installed at the docks of the United States Steel Corporation, Conneaut, Ohio.

S. F. BOWSER & CO., INC., Fort Wayne, Ind.; leaflet, illustrating the Bowser system of battery storage for lubricating oil for motor vehicles.



CONSTRUCTION NEWS

OF SPECIAL INTEREST TO ENGINEERS, CONTRACTORS, BUILDERS AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES

Price advances are indicated by heavy type; declines by *italics*.

PIG IRON—	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$30.35	$30.35
Northern Basic	27.55	27.55
Southern Ohio No. 2	28.55	28.55
NEW YORK, tidewater delivery		
2X Virginia (silicon 2.25 to 2.75)	32.40	32.40
Southern No. 2 (silicon 2.25 to 2.75)	35.20	35.20
BIRMINGHAM		
No. 2 Foundry	27.75	28.00
PHILADELPHIA		
Eastern Pa.	30.65*	30.65
Virginia No. 2	32.10–34.10†	32.10–34.10
Basic	30.90*	30.90
Grey Forge	29.90*	29.90
CHICAGO		
No. 2 Foundry Local	26.75	26.75
No. 2 Foundry Southern	28.00	28.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	28.15	28.15
Basic	27.15	27.15
Bessemer	29.35	29.35

* F. o. b. furnace. † Delivered.

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f. o. b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh		Chicago	
	Current	One Year Ago	Current	One Year Ago
Standard bessemer rails	$45.00	$55.00	$45.00	$65.00
Standard openhearth rails	47.00	57.00	47.00	67.00
Light rails, 8 to 10 lb.	2.58½*	3.13*	2.83½*	3.13 *
Light rails, 12 to 14 lb.	2.54*	3.09*	2.79*	3.09*
Light rails, 25 to 45 lb.	2.45*	3.00	2.70*	3.00*

*Per 100 lb.

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh				
	Current	One Year Ago	Chicago	St. Louis	San Francisco
Standard spikes, ⅝-in. and larger	$3.35	$3.90	$4.27	$4.44	$5.65
Track bolts	4.35	4.90	5.17	Premium	6.65
Standard section angle bars	3.00	....	4.22	Premium	4.60

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

		7 In. x 9 In. by 8 Ft. 6 In.	6 In. x 8 In by 8 Ft.
Chicago	Plain	$1.48	$1.33
San Francisco	Douglas Fir—Green	1.42	1.00
San Francisco	Douglas Fir—Creosoted	2.12	2.00

Prices per tie at Missouri mills; St. Louis prices about 25c. higher:

Untreated A Grade White Oak 6x8x8		Untreated A Grade Red Oak 6x8x8	
No. 1	$0.70	No. 1	$0.55
No. 2	.80	No. 2	.65
No. 3	.90	No. 3	.75
No. 4	.98		
7x9x8 white oak			1.05
7x9x8 red oak (No. 4)	$0.80	No. 5	.87

Note.—Add 36c. each for treatment.

PIPE

STEEL—From warehouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
¼ to 3 in. butt welded	47%	57.5%	45%
2½ to 6 in. lap welded	42%	53.5%	41½%

	Galvanized		
	New York	Chicago	St. Louis
¼ to 3 in. butt welded	31%	44%	30½%
2½ to 6 in. lap welded	27%	41%	27½%

Malleable fittings, Class B and C, from New York stock sell at +12½% list prices. Cast iron, standard sizes, 10% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York						
	Current	One Month Ago	One Year Ago	Chicago	St. Louis	San Francisco	Dallas
4 in.	$57.30	$55.30	$64.75	$58.80	$52.00	$77.55	$65.00
6 in. and over	54.30	52.30	61.75	55.80	49.00	74.55	62.00

Gas pipe and 16-ft. lengths are $1 per ton extra.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Mar. 21, 1919.

BUTT WELD

Steel			Iron		
Inches	Black	Galvanized	Inches	Black	Galvanized
⅛, ¼ and ⅜	50%	24%	¾ to 1¼	39½%	23½%
½	54½%	40%			
¾ to 3	57½%	44%			

LAP WELD

2	50½%	35%	2	32½%	18½%
2½ to 6	53½%	41%	2½ to 6	34½%	21½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

⅛, ¼ and ⅜	46½%	29%	¾ to 1¼	39½%	24½%
½	51½%	39%			
¾ to 1¼	55½%	43%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	48½%	37%	2	33½%	20½%
2½ to 4	51½%	40%	2½ to 4	35½%	23½%
4½ to 6	50½%	39%	4½ to 6	34½%	22½%

Malleable fittings. Class B and C, banded from New York stock sell at list 2% off. Cast iron, standard sizes, 20% off.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

	New York					
Size, In.	Current	One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$35.00	$35.00	$22.50	$30.00	.....	$33.44
4	51.00	51.00	27.00	40.00	$45.00	50.16
5	65.00	65.00	45.00	50.00	65.00	62.70
6	90.00	90.00	55.00	60.00	90.00	83.60
8	130.00	130.00	100.00	80.80	150.00	133.76

SEWER PIPE—The following prices are in cents per foot for carload lots:

	New York					
Size, In.	Current	One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$0.09	$0.126	.....	$0.09	.....	$0.132
4	.09	.126	.....	.09	$0.15	.132
5	.135	.189	.....	.135	.1875	.207
6	.135	.189	$0.16	.135	.225	.207
8	.21	.294	.21	.21	.3475	.2875
10	.315	.441	.29	.315	.45	.4025
12	.405	.567	.37	.405	.60	.5175
15	.51	.766	.56	.54	.9375	.7475
18	.75	1.05	.91	.875	1.275	.9775
20	.90	1.26	1.14	1.05	1.71	1.15
22	1.20	1.68	1.46	1.40	.....	1.495
24	1.35	1.935	1.56	1.80	2.125	1.725
27	2.145	2.795	1.90	2.75	.....	2.5875
30	2.376	3.096	2.57	3.45	.....	3.1625
33	3.15	4.05	3.09	4.00	.....	4.025
36	3.5875	4.6125	3.37	4.35	.....	4.60

	3	5	8	12	24	36
Boston	$0.078	$0.117	$0.182	$0.351	$1.17	$3.28
St. Paul	.12	.18	.28	.45	2.00	4.75
Denver	.105	.16	.25	.425	1.575	.....
Seattle	.....	.....	.36	.64	2.25	.....
Kansas City	.12	.18	.25	.50	1.80	4.60
Los Angeles	.0825†	.1375†	.2475	.44	1.50†	.....
New Orleans			50 per cent. off			
Cincinnati	.08	.1215	.189	.3645	1.215	3.1775
Atlanta	....	....	.34	.55	2.00	....
Montreal			58 per cent. off			
Detroit	.081	.1215	.189	.3645	1.215	2.7675
Baltimore	.114	.171	.266	.513	1.71	.....

†4-in., 6-in., 30-in. respectively.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8000 gal. minimum f.o.b. place named:	Current	One MonthAgo
New York, 45-65% asphalt	$0.04½	$0.04½
New York, liquid asphalt	.06	.06
New York, binder	.06½	.06½
New York, flux	.04½	.04½
St. Louis, 40% asphalt	.0412	.06
Chicago, 15-20% asphalt	.10	.10
Chicago, 100% dust layer	.11	.11
Dallas, 40-50% asphalt	.07	.07
Dallas, 60-70% asphalt	.08	.08
Dallas, 75-90% asphalt	.10	.10
San Francisco, 75-95% asphalt, per bbl.	2.10	2.10

ASPHALTUM—Price per ton in packages and bulk in carload lots:

	Brand	Package	Bulk
New York	Texaco	18.00	$14.00
Chicago	Mexican	33.00	31.00
San Francisco	California	17.00	13.75
Dallas	Texaco and Mexican	32.00	30.00
Seattle	D grade	23.50	.....
Denver	Trinidad	45.00	.....
Denver	California	38.00	.....
St. Paul	Mexican	21.00	.....
Kansas City	Mexican	*26.00*	*24.00*
Atlanta	Standard	24.00	19.80
New Orleans		16.50	.....
St. Louis	Stanolind	24.90	18.40
Detroit	Bermudez	48.00	.....
Baltimore	Manco	43.00	.....
Los Angles		.....	13.50
Montreal		.....	18.70

PAVING STONE—

Chicago	About 4x8x4 dressed	$2.45	sq.yd.
	About 4x8x4 common	2.20	sq.yd.
San Francisco	Basalt block 4x7x8	57.75	per M
Kansas City	Granite	3.00	sq.yd.
Boston	5-in. granite	110.00	per M
St. Paul	Sandstone	1.75	sq.yd.
Atlanta	Granite	1.85	sq.yd.
Detroit	Granite, small	2.75	sq.yd.
Baltimore	Common	*2.25*	sq.yd.
Montreal	Granite	5.90	sq.yd.

FLAGGING—

New York	Bronx	$0.21	sq.ft.
	Manhattan	.22	sq.ft.
	Queens, 5 ft. square	.23	sq.ft.
	5x20-in. cross-walk	.75	lin.ft.
Chicago	18 in. wide	.70	lin.ft.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York	3½	16	$3.25
New York	4	16	3.50
Chicago	4	16	3.10
Chicago	3½	16	2.95
Chicago	City specifications		3.10
St. Louis	3½	16	2.45
St. Louis	4	16	2.70
Seattle	4	16	2.55
Kansas City	4	16	3.00
St. Paul	3½	..	3.13
Atlanta	3½	16	2.25
New Orleans	3½	16	2.63
New Orleans	4	16	3.00
Dallas	3½	18	3.17
Dallas	4	18	3.56
Baltimore	3½	16	3.60
Montreal	4	16	4.60

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots is as follows, per cu.yd.:

	Gravel 1½ In.		Gravel ¾ In.		Sand	
	Current	One Yr. Ago	Current	One Yr. Ago	Current	One Yr. Ago
New York	$2.00	$2.00	$2.00	$2.00	$1.25	$1.25
Denver	1.60	1.60	1.60	1.60	1.25	1.10
Chicago	1.35	1.45	1.35	1.45	1.35	1.45
Kansas City	2.50	2.15	3.00	2.60	1.00†	.50‡
St. Louis*	1.78	1.25	1.82	1.35	1.68	1.45
Seattle	1.25	1.00	1.25	1.25	1.25	1.25
Dallas	2.50	2.00	2.50	2.00	2.25	1.40
St. Paul	1.25	1.25	1.35	1.50	.60	.60
San Francisco	1.15	1.20	1.15	1.20	1.15	1.20
Boston	1.60	2.00	1.60	1.75–2	1.00	1.00
New Orleans	*2.40*	1.50	2.40	.70	1.20	2.25
Atlanta	2.00‡	.....	.....	.....	1.10‡	.....
Detroit	2.00	.....	2.00	.....	2.00	.....
Baltimore	1.54	.....	1.75	.....	.65	.....
Montreal	1.20‡	.....	.....	.....	1.10‡	.....

*Fine white sand, Pacific and Ottawa per ton, *6. †Kaw River sand is $1.50 per yd. per ton.

CRUSHED STONE—Price for cargo or carload lots is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1.65-1.75	$1.70	$1.75-1.85	$1.85
Chicago	1.30	1.20	1.30	1.20
St. Louis	1.50	1.08	1.50	1.08
Dallas	2.70	1.51	2.70	1.55
San Francisco	1.50	1.20	1.50	1.20
Boston	3.00*(del)	1.75	3.00*(del)	1.75
St. Paul (lime)	1.15†	1.15	1.25	1.40
Denver	....	1.60	1.60	1.60
Kansas City	1.90	1.70	2.00	1.80
Seattle	1.50	1.30	1.50	1.30
Atlanta	2.25	1.50*	2.35*	....
New Orleans	4.00	....	4.35	....
Los Angeles	1.20	1.50	1.20	1.60
Detroit	*1.65*	....	*1.65*	....
Baltimore	1.25	....	1.50	....
Montreal	1.90*	....	2.15*	....

*Per ton. †Limestone: traprock, $1.60 and $1.80 per ton for 1½ and ¾-in.

LIME—Warehouse prices:

	Hydrated per Ton Finished	Hydrated per Ton Common	Lump per 200-Lb. Barrel Finished	Lump per 200-Lb. Barrel Common
New York	$17.50	$14.50	$2.90*	$2.65*
Kansas City	*21.00*	21.00	2.30	2.20
Chicago	18.00	17.50	1.80	1.10
St. Louis	22.00	18.00	....	2.00
Boston	22.75	18.25	3.75*	3.40*
Dallas	30.00	....	2.75	....
Cincinnati	13.60	11.95	13.70‡	10.70‡
San Francisco	30.00	....	2.80†	....
St. Paul	23.00	20.00	1.60	1.50
New Orleans	.....	17.50	....	2.20
Atlanta	....	1.90	1.80	1.95
Detroit	20.00	18.40	3.00*	3.00*
Seattle	30.00	.....	3.05†	2.80†
Los Angeles	.....	.....	3.05†	2.80†
Baltimore	*18.75*	*18.75*	....	11.37‡
Montreal	23.00	20.00	15.00‡	15.00‡

* 300-lb. barrels. † Per 180-lb. barrel. ‡ Per ton.
NOTE—Refund of 10c. per barrel.

NATURAL CEMENT—Price to dealers for 500 bbl. or over, f.o.b., exclusive of bags:

St. Paul (Austin)	$1.45
Kansas City (Ft. Scott)	1.40
New Orleans	2.52
Atlanta (Magnolin)	1.85

PORTLAND CEMENT—Current prices are for barrels in carload lots, without bags, to contractors:

	Current	One Month Ago Without Bags	One Year Ago With Bags
New York	$2.30	$2.30	$3.55
Jersey City	2.27	2.27	2.99
Boston	2.42	2.42	3.00
Chicago	2.00	2.00	2.45
Pittsburgh	2.05	2.05	2.55
Cleveland	2.32	2.32	2.72
Detroit	2.08	2.08	2.68
Indianapolis	2.27	2.27	2.62
Toledo	2.12	2.12	2.62
Milwaukee	2.11	2.11	2.56
Duluth	2.10	2.10	2.60
Peoria	2.12	2.12	2.56
Cedar Rapids	2.18	2.18	2.68
Davenport	2.14	2.14	2.64
St. Louis	2.20	2.20	2.70
San Francisco	2.43	2.43	2.88
New Orleans	2.36	2.36	....
St. Paul	2.20	2.20	2.80
Denver	2.67	2.67	3.07
Kansas City	2.26	2.26	2.70
Seattle	2.53	2.53	3.33
Dallas	2.03	2.03	2.60
Atlanta	2.50	2.50	....
Cincinnati	2.90	2.90	2.80
Los Angeles	2.78	.....	2.78

NOTE—Bag charge is generally 15c. each.

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH x 4-INCH MESH

Style Number	Sectional Area per Square Ft.	Inches Width	Pittsburgh	New York	Chicago	St. Louis	Dallas	San Francisco
032	0.032		$0.92	$1.16	$0.98	$0.99	$1.13	$1.32
049	0.049		1.18	1.48	1.26	1.26	1.43	1.67
068	0.068		1.44	1.86	1.53	1.56	1.79	2.06
093	0.093		1.85	2.39	1.97	2.00	2.41	2.65
126	0.126		2.28	3.02	2.43	2.47	2.92	3.28
153	0.153		2.72	3.59	.90	2.95	3.48	3.93
180	0.180		3.12	4.13	3.33	3.39	3.99	....
245	0.245		4.12	5.44	4.40	4.47	5.27	....
287	0.287		4.76	6.29	5.08	5.16	6.10	6.86
336	0.336		5.52	7.30	5.89	5.99	7.06	....
395	0.395		6.40	8.45	6.83	6.94	8.19	....

PAVING

036P	0.036		$0.71	$0.92	$0.76	$1.77	$0.80	....
053P	0.053		1.00	1.28	1.06	1.08	1.12	....
072P	0.072		1.26	1.66	1.34	1.37	1.46	....
097P	0.097		1.62	2.12	1.73	1.76	1.88	....
049R	0.049		1.00	1.28	1.06	1.08	1.12	....
067R	0.067		1.26	1.65	1.4	1.37	1.46	....
089R	0.089		1.62	3.11	1.73	1.76	1.88	....

Made in 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52- and 56-in. width in rolls 150-, 200- and 300-ft. lengths. Galvanized is about 10% higher.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	New York Current	New York One Year Ago	Chicago	St. Louis	San Francisco	Dallas
27	233	$29.10	$34.07	$29.00	$29.00	$34.00	$32.75
26	250	30.45	35.23	30.50	30.00	35.00	34.50
25	300	31.90	36.51	32.00	....	37.00	36.75
24	340	33.50	37.73	33.00	33.00	40.25	39.25
22	450	36.60	40.48	.....	.....	.....	43.30

About 10% additional for smaller quantities.

BARS, CONCRETE REINFORCING—Following quotations are per 100 lb:

ROLLED FROM BILLETS

In.	Mill Pittsburgh	Warehouse, Uncut New York Current	New York One Year Ago	Chicago	St. Louis	Dallas	San Francisco
½ and larger	$2.35	$3.37	$4.14‡	$3.37	$3.68	$4.75	$4.60
⅝	2.40	3.42	4.19‡	3.42	3.74	4.80	4.65
¾	2.45	3.47	4.24‡	3.47	3.79	4.95	4.70
⅞	2.60	3.62	4.39‡	3.62	4.04	5.00	4.85
1	2.85	3.87	4.64‡	4.87	4.19	5.05	5.10

Twisted bars cut to length take extra of 27½c. per 100 lb. Extra on deformed bars, uncut, 7½c.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ in. and larger	$3.45	$3.45	$4.25	⅝	$3.70	$3.70	....
¾	3.50	3.50	4.30	⅞	3.95	....	....
1	3.55	3.55	....				

BRICK—To contractors price per 1000 in cargo or carload lots is as follows:

	Common Current	Common One Month Ago	Common One Year Ago	Paving Brick	Paving Block
New York	$15.00	$15.00	$14.00	No Quotations	
Chicago	12.00	12.00	11.00	....	....
St. Louis, selected	18.00*	16.00	16.00	$26.00	....
St. Louis, salmon	12.00	10.00	10.00	....	38.00
Denver	14.00†	13.00	9.50	....	....
Dallas	18.57	18.00	14.03	27.30	....
San Francisco	12.50	12.50	12.00	....	....
Boston	18.00	18.00	16.00	30.00	45.50
New Orleans	19.00	17.50	19.00	18.50	18.50
St. Paul	13.00	13.00	9.40	30.00	36.50
Kansas City	16.00	15.00	13.00	42.50	....
Seattle	15.00	15.00	15.00	....	42.00
Cincinnati	17.00	16.00	13.00	....	....
Atlanta	16.00	15.00	....	40.00	....
Los Angeles	12.50	12.50	10.00	....	....
Montreal	15.00	15.00	.....	81.00	....
Detroit	20.00	19.00	.....	37.00	....
Baltimore (del)	18.00	18.00	.....	22.00	*12.50*

† Salmon is $13 in Denver. * Hard brick, $14.

HOLLOW TILE—Price per block in carload lots for hollow building tile:

	New York Current	New York One Year Ago	Chicago	St. Louis	San Francisco	Dallas	Factory Perth Amboy, N. J.
4x12x12	$0.11475*	$0.10125	$0.08	$0.08	$0.1125	$0.1088	
6x12x12	.153*	.13500	.112	.105	.15	.09	$0.1512
8x12x12	.204*	.....	.144	.15	.....	.115	.1944
10x12x12	.....	.....	.168	.17	.....	.2546	.2268
12x12x12	.....	.....	.208	.208	....	.3082	.2916

*Delivered below 72nd St.

	4x12x12	8x12x12	12x12x12
Boston	$0.10	$0.22	$0.30
St. Paul	.065	.13	.185
Cincinnati	.78	.104	.20925
Kansas City	.0786	.15	.205
Denver	.1250	.18	.25
Seattle	.09	.175	.30
Atlanta	.09	.16	.25
Los Angeles	.082	.154	
New Orleans	.165	.22	.325
Detroit	.0842	.1579	.2264
Baltimore	.115	.21	.2875
Montreal	.19	.28	.34

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh, together with quotations per 100 lb. from warehouses at places named:

	Mill Pittsburgh	New York Current	New York 1 Yr. Ago	St. Louis	Chicago	San Francisco	Dallas
Beams, 3 to 15 in.	$2.45	$3.47	$4.24	$3.54	$3.47	$4.45	$5.50
Channels, 3 to 15 in.	2.45	3.47	4.24	3.54	3.47	4.45	5.50
Angles, 3 to 6 in., ¼ in. thick	2.45	3.47	4.24	3.54	3.47	4.45	5.50
Tees, 3 in. and larger	2.45	3.52	4.24	3.54	3.47	4.45	5.50
Plates	2.66	3.67	4.49	3.54	3.67	4.90	5.75

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Mill Pittsburgh	New York Current	New York One Yr. Ago	Warehouse Chicago	Warehouse St. Louis	Warehouse San Francisco	Warehouse Dallas
½ in. and larger	$4.20	$4.72	$5.65	$4.72	$4.79	$6.05	$7.50

CONE HEAD BOILER

½ in. and larger	4.30	4.82	5.75	4.82	4.89	6.15	7.50
⅝ and ¾	4.45	4.97	5.90	4.97	5.04	6.30	7.50
⅞ and 1	4.70	5.32	6.25	5.32	5.29	6.65	7.75

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2in. take an extra of 25c.

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square as follows in New York, St. Louis, Chicago and San Francisco:

	1-Ply e.l.	1-Ply l.el.	2-Ply e.l.	2-Ply l.el.	3-Ply e.l.	3-Ply l.e.
No. 1 grade	$1.50	$1.75	$1.90	$2.15	$2.30	$2.55
No. 2 grade	1.35	1.60	1.70	1.95	2.05	2.30

Asbestos asphalt-saturated Felt (14 lb. per square) costs $156 per ton.

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.25 per roll in carload lots and $2.50 for smaller quantities.

Shingles, red and green slate finish, cost $6.00 per square in carloads; $6.25 in smaller quantities, in Philadelphia.

ROOFING MATERIALS—Prices per ton f.o.b. New York and Chicago:

	Carload Lots N. Y.	Carload Lots Chicago	Less Than Carload Lots N. Y.	Less Than Carload Lots Chicago
Tar felt (14 lb. per square of 100 sq.ft.)	$70.00	$70.00	$71.00	$71.00
Tar pitch (in 400-lb. bbl.)	21.00	18.00	22.00	19.00
Asphalt pitch (in barrels)	34.00	34.00	37.50	37.50
Asphalt felt	68.00	48.00	72.50	72.50

SHEETS—Quotations are in cents per pound in various cities from warehouse also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	St. Louis	Chicago	San Francisco	New York Current	New York One Yr. Ago
No. 10	3.55	4.64	4.57	5.80	4.57	5.495
No. 12	3.60	4.69	4.62	5.75	4.62	5.545
No. 14	3.65	4.74	4.67	5.90	4.67	5.595
No. 16	3.75	4.84	4.77	6.00	4.77	5.695
Black						
*Nos. 18 and 20	4.15	5.24	5.42	6.75	5.30	6.295
*Nos. 22 and 24	4.20	5.29	5.47	6.80	5.35	6.345
*No. 26	4.25	5.34	5.52	6.95	5.40	6.395
*No. 28	4.35	5.44	5.62	7.05	5.50	6.595
Galvanized						
No. 10	4.70	5.79	5.97	....	6.20	6.845
No. 12	4.80	5.89	6.07	7.30	6.25	6.945
No. 14	4.80	5.89	6.07	7.30	6.30	6.945
Nos. 18 and 20	5.20	6.19	6.37	7.60	6.60	7.245
Nos. 22 and 24	5.25	6.34	6.52	7.75	6.75	7.295
*No. 26	5.40	6.04	6.67	7.90	6.90	7.445
*No. 28	5.70	6.79	6.97	8.20	7.20	7.745

*For painted corrugated sheets add 30c. per 1000 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York Current	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Raw in barrel	$2.25	$1.86	$2.50	$2.00	$2.48	$2.05
5-gal. cans	2.40	1.96	2.75	2.15	2.68	2.25

WHITE AND RED LEAD—Base price per pound:

	Red Current Dry	Red Current In Oil	Red 1 Year Ago Dry	Red 1 Year Ago In Oil	White Current Dry and In Oil	White 1 Yr. Ago Dry and In Oil
100-lb. keg	13.00	14.50	11.25	11.00	13.00	10.50
25 and 50-lb. kegs	13.25	14.75	11.50	11.25	13.25	10.75
12½-lb. keg	13.50	15.00	11.75	11.50	13.50	11.00
5-lb. cans	15.00	16.50	13.25	13.00	15.00	13.00
1-lb. cans	16.00	17.50	13.25	13.00	16.00	13.00

500 lb. lots less 10% discount; 2000 lb. lots less 10-2½% discount.

LUMBER

San Francisco—Prices of rough Douglas fir No. 1 common, in more than carload lots:

	Lumber Prices in Yards at San Francisco 6-8-12 and 14 Ft.	10-16-18 and 20 Ft.	22 and 24	25 to 32 Ft.
3x3 and 4	$34.50	$35.00	$36.00	$38.00
3x6 and 8	35.50	36.00	37.00	39.00
4x4-6 and 8	36.00	37.00	38.00	40.00
3x10 and 12	36.00	37.00	38.00	40.00
3x14	36.50	37.50	38.50	40.50
4x10 and 12	36.00	37.00	38.00	40.00
4x14	37.00	38.00	39.00	41.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$35.50	$37.50	$38.50
6x14	37.00	39.00	40.00
8x10	35.50	37.50	38.50
8x14	37.00	39.00	

New York, Chicago and St. Louis

	Southern Pine New York* 20 Ft. and Under	Southern Pine New York* 22-24 Ft.	Southern Pine Chicago 20 Ft. and Under	Southern Pine Chicago 22-24 Ft.	Yellow Pine St. Louis 20 Ft. and Under	Yellow Pine St. Louis 22-24 Ft.
3x 4 to 8x 8	$48.00	$49.00	$51.00	$52.00	$40.00	$42.00
3x10 to 10x10	52.00	53.00	55.00	56.00	43.00	45.00
3x12 to 12x12	56.00	57.00	57.00	58.00	45.00	46.50
3x14 to 14x14	60.00	61.00	62.00	63.00	50.00	52.00
3x16 to 16x16	69.00	70.00	65.00	66.00	53.00	55.00
3x18 to 18x18	74.00	75.00	69.00	70.00	57.00	58.00
4x20 to 20x20	99.00	80.00	.....	.....	.....	.....

* Prices from Lumbermen's Bureau.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 40 ft. for sizes 12 x 12 and under; for sizes over 12 x 12 add $2. For merchantable add $2 to sizes 10 x 10 and under. For prime add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20-Ft. and Under P.	8 x 8-In. x 20-Ft. and Under Fir	8 x 8-In. x 20-Ft. and Under Hemlock	8 x 8-In. x 20-Ft. and Under Spruce	12 x 12-In. 20 Ft. and Under P.	12 x 12-In. 20 Ft. and Under Fir
Boston	$50.00	$49.00	$48.00	$48.00	$50.00	$50.00
Kansas City	51.00	51.25	51.25	.....	57.00	48.50
Seattle	.....	30.00	.....	.....	.....	31.00
New Orleans	45.00	.....	.....	.....	48.00	.....
St. Paul	60.00	61.00	60.00	46.00	62.00	63.00
Atlanta	55.50	57.50	58.00	68.00	68.50	70.50
Baltimore	46.00	.....	.....	.....	60.00	.....
Cincinnati	45.00	45.00	42.00	42.00	48.00	48.00
Montreal	58.00	65.00‡	65.00	58.00‡	58.00	58.00

	1-In. Rough, 10 In. x 16 Ft. and Under P.	1-In. Rough, 10 In. x 16 Ft. and Under Fir	1-In. Rough, 10 In. x 16 Ft. and Under Hemlock	2-In. T. and Gr. 10 In. x 16 Ft. P.	2-In. T. and Gr. 10 In. x 16 Ft. Fir
Boston	$50.00	$50.00	$48.00	$50.00	$50.00
Kansas City	78.50	64.75	64.75	81.75	77.75
Seattle	.....	31.50	.....	.....	31.50
New Orleans	54.00	.....	.....	55.25	.....
St. Paul	58.00	55.00	54.00	63.00	56.00
Atlanta	80.00	85.00	.....	65.00	67.50
Baltimore	42.00	.....	.....	40.00	.....
Cincinnati	45.00	43.00	42.00	45.00	45.00
Montreal	60.00*	59.00	44.00	65.00	63.00

* 2x8 costs †56. † Up to 32 ft., above that add $4. ‡ Also tamarac.

Los Angeles—Base price (2x3x16 ft.), Douglas fir or hemlock, $43.
Detroit—Base price, yellow pine (8x8x20), $43.

Dallas—Yellow pine. Price per M:

2x4 to 2x12—12, 14 and 16	$57.50
2x4 to 2x12—10, 18 and 20	60.00
2x4 to 2x12—22 and 24	62.50
4x4, 4x6, 6x6, 8x8 and 3x8	61.25
8x10, 10x10 and 3x10	62.50
12x12 and 3x12	67.50

NAILS—The following quotations are per keg from warehouse:

	Mill Pittsburgh	St. Louis	Chicago	San Francisco	Dallas
Wire	$3.25	$3.90	$3.90	$5.25	$5.00
Cut	4.25	5.48	5.50	6.65	6.40

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb.:

Boston	$0.30	New Orleans	$0.38½
Buffalo	.17	New York	.27
Chicago	.27	Pacific Coast (all rail)	1.25*
Cincinnati	.23	Philadelphia	.24½
Cleveland	.17	St. Louis	.24
Denver	.99	St. Paul	.49½
Kansas City	.59	Detroit	.33
		Baltimore	.33

Note—Add 3% transportation tax. * Minimum carload, 80,000 lb.

Contractors' Miscellaneous Supplies

STEEL SHEET PILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$2.55	$2.55	$4

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	New York and St. Louis
Galvanized iron rigging	+12½%
Galvanized cast steel rigging	7½%
Bright plow steel	35%
Bright cast steel	22½%
Bright iron and iron tiller	5

San Francisco: Galvanized, less 5%, bright, less 25%.
Chicago, +5 on galvanized, 30-2½ off on bright.

MANILA ROPE—For rope smaller than ¼-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft. there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¼-in., 8 ft.; ⅜-in., 6; ½-in., 4½; ⅝-in., 3½; ¾-in., 2 ft. 10 in.; ⅞-in., 2 ft. 4 in. Following is price per pound for ¼-in. and larger, in 1200-ft. coils:

Boston	$0.25	Kansas City	$0.27
New York	.27	New Orleans	.25½
Chicago	.26½	Los Angeles	.28
St. Paul	.28	Seattle	.25
San Francisco	.24	St. Louis	.26½
Atlanta	.29½	Montreal	.32
Denver	.29½	Detroit	.28
Cincinnati	.29	Baltimore	.25

EXPLOSIVES—Price per pound of dynamite in small lots and price per 25 lb keg for black powder.

	Low Freezing	Gelatin			Black
	40%	40%	60%	80%	Powder
New York	.....	$0.27½	$0.30	.....	$2.40
Boston	$.2225	.2425	.2675	$.3100	2.20
Kansas City	.19	.2375	.2625	.30	2.25
New Orleans	.2375*	.2275	.2475	.....	....
Seattle	$0.1425	$0.185	$0.21	$0.315	$1.90
Chicago	.1875	.2125	.2550	.2975	2.15
St. Paul	.19	.2375	.2625	.....	2.45
St. Louis	.19	.2325	.2375	.3000	2.40
Denver	.1775	.22	.245	.2875	2.25
Dallas	.....	.....	.288	.342	2.75
Los Angeles	.21	.26	.30	2.75	.....
Atlanta	.20	.225	.245	.....	2.45
Baltimore	.19	.23½	.28½	.30	2.35
Cincinnati	.1875	.2125	.2325	.....	2.35
Montreal	.28	.31	.34	.39	.....

* For 50%.

POLES—Price of Western red cedar poles is as follows:

	New York				
	Current	One Year Ago	Chicago	St. Louis	Denver
6-in. x 30-ft.	$5.82	$5.60	$5.17	$4.55	$5.17
7-in. x 30-ft.	7.65	7.45	6.85	6.10	6.85
7-in. x 35-ft.	11.10	10.80	10.00	8.95	10.00
8-in. x 30-ft.	12.65	12.30	11.35	10.10	11.35
7-in. x 40-ft.	12.85	12.50	11.50	10.20	11.50
8-in. x 45-ft.	18.90	18.40	16.90	15.00	16.90
8-in. x 50-ft.	22.65	22.05	20.30	18.00	20.30

10c. higher freight rates on account of double loads.

For plain pine poles, delivered New York, the price is as follows:

10-in. butts, 5-in. tops, length 20-30 ft.	$9.00
12-in. butts, 6-in. tops, length 30-40 ft.	11.50
12-in. butts, 6-in. tops, length 41-50 ft.	12.50
14-in. butts, 6-in. tops, length 51-60 ft.	21.00
14-in. butts, 6-in. tops, length 61-71 ft.	23.50

Note—At the present time it is almost impossible to give accurate prices on poles. The above are only nominal.

	Dallas Aug. 1, 1919
6-in. x 20-ft.	$4.60
6-in. x 30-ft.	7.10
8-in. x 30-ft.	8.45
8-in. x 35-ft.	10.38

OLD MATERIAL—The prices following are per gross ton paid to dealers and producers in New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$23.00	$21.00	$22.00
Stove plate	17.50	22.00	22.50
No. 1 machinery cast	25.00	24.00	23.50
Machine shop turnings	11.00	10.00	13.00
Cast borings	11.00	12.50	13.00
Railroad malleable cast	16.00	20.75	20.50

SHIP SPIKES—Current prices per 100 lb.

	San Francisco		Seattle
In.	Galv.	Black	Black
¼	$9.20	$8.50	$8.55
½	8.75	6.75	8.25
¾	8.60	6.60	8.30

Pittsburgh base, $3.85 per 100 lb.

LABOR RATES AND CONDITIONS THROUGHOUT THE COUNTRY

S means scarce; E, enough; P, plentiful

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.90S	$0.70	$0.50	$0.45	$0.60	$0.75	$0.35
Baltimore	1.00E	0.85P	0.87½E	0.46 to 0.54E	0.74S	0.87½E	0.35 to 0.43S
Boston	.60-.70P	.80-.90P	.80-1.00P	.60-.70P	80P	.80-1.00P	.52½- .62½P
Cincinnati	.....	.....	.70	.....	.50	.....	.....
Dallas	1.00E	.87½S	.87½E	.37½-.40S	.....	.75S	.35S
Denver	1.00E	.87½	.93¾	.59¾	.....	.87½	.40-.50
Detroit	1.00S	.80P	.90P	.60S	.90	.85-.90	.55S
Kansas City	1.00	.85	.90	.68¾	.77½	.90	.57½
Los Angeles	.87½E	.75E	.75P	.56-.75S	.75P	.75P	.50-.62½E
Montreal	.75	.70S	.60S	.45-.50S	.55P	.40-.55S	.30-.45S
New Orleans	.87½S	.75	1.00	.60	.80-1.00	.75	.30-.35
New York	.87½	.81¼	.87½	.57½	.81¼	.87½	.56¼
Pittsburgh	1.00	.90	.90	.60	.60	1.00	.40-.45S
St. Louis	1.00	.87½	1.00-1.12½	.70	.80-.92½	.90	.40-.45
St. Paul	.87½	.75	.80	.50	.80	.85	.47½
San Francisco	1.25E	1.00E	1.00E	.87½E	1.00E	1.00E	.45-.50E
Seattle	1.12	.93¾	.94	.75-.80	.90	1.00	.75S

Remarks

Atlanta—Some bricklayers are receiving $1 to $1.25 an hour. General shortage of skilled labor. No strikes.

Baltimore—Structural iron workers are asking $1.

Boston—Common labor is being obtained at considerably less than the union scale; in some cases as low as 35c.; on larger jobs, 45c.

Denver—All classes are asking for $1, decision wanted Sept. 1.

Los Angeles—No general strikes. In San Diego carpenters have struck on several jobs for $7 a day.

Montreal—Bricklayers threaten strike. Some carpenters and structural iron workers on strike. Good labor scarce account of exodus of foreigners, which comprise 75 per cent. of Canadian labor.

New York—Bricklayers on strike since Aug. 15, for $10 a day; painters on strike for $8.

Pittsburgh—No strikes.

St. Louis—Skilled labor, 50c. to 70c. Building laborers 50c. Bricklayers on sewers, 50c.

St. Paul—On Aug. 12, bricklayers asked for $1, ignoring agreement to work until May 1, 1920, at 87½c. Sewer diggers, 50c. an hour; paving-block layers, 50c.; teams, 90c

San Francisco—All lines busy. No strikes.

Seattle—Considerable residence construction; building construction improved over last month. Street and road work booming. Labor situation easier, although there is a shortage in skilled labor.